RUDRAPRASAD CONSULTANTS

NAME OF WORK: Restoration and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju layout, jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ward no -03 of Yelahanka New town Sub division (PACKAGE NO-13) (Number of Works-03)

DETAILED PROJECT REPORT

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Table of Contents

1.	**INTRODUCTION**	1
1.1	General	2
1.2	Topography	5
1.3	Project Objective	6
1.4	Outline of the project	6
1.5	Contents of Detailed Project report	6
2.	**SOCIO – ECONOMIC PROFILE**	7
2.1	General	8
2.2.	Geography	8
2.3.	Climate	9
2.4.	Transport	10
	2.4.1. Air	10
	2.4.2. Rail	10
	2.4.3. Road	10
2.5	Economy	11
2.6	Karnataka State Economy	12
2.7	Contribution to Economy by Sector	13
2.8	Economic Situation	15
3.	**DESCRIPTION OF PROJECT ROADS**	16
3.1. General		17
3.2. Existing Project Road		19
	3.2.1. Terrain	19
	3.2.2. Alignment	19
	3.2.3. Climate	19

	3.2.4. Carriage Way Width	19
	3.2.5. Pavement Condition	20
	3.2.6 Land Use along the Project Highway	22
3.3	Traffic Flow Conditions	22
3.4	Cross Drainage Structures and Side Drains	22
3.5	Utilities	23
3.6	Trees	23
4.	**METHODOLOGY**	24
4.1.	General	25
4.2.	Reconnaissance Survey	25
4.3.	Road Inventory Survey .	25
4.4.	Pavement Condition Survey	26
	4.4.1. Visual Condition Survey	26
	4.4.2. Pavement Structural Strength	26
4.5	Pavement Composition	28
4.6	Subgrade Characteristics and Strength	28
4.7	Topographical Survey	29
	4.7.1 GPS Stations	29
	4.7.2 Detailed Topographic Survey	29
	4.7.3 Inventorv of bridge and CD works and Culverts	30
	4.7.4 General repairs to Side drains	30
5.	**DESIGN STANDARDS**	31
5.1.	Introduction	32
5.2.	Design Standards for Geometric Design	32
5.3.	Design Standards for Pavement Design and Pavement Overlay Design	34

5.4.	Design Standards Related to Road Drainage	35
5.5.	Design Standards Related to Utility, Road Furniture and Appurtenances	36
5.6.	Material specifications	37
6.	**PAVEMENT DESIGN**	38
	FLEXIBLE PAVEMENT DESIGN	
6.1	Methodology	39
	6.1.1 Pavement Overlay Design	39
6.2.	Pavement Investigations	39
	6.2.1 Introduction	39
	6.2.2 Pavement Crust Details	40
	6.2.3 Existing Subgrade Soil Classification	40
6.3	Computation of Design Traffic (As per IRC-37, 2012)	40
7.	**CONCLUSIONS**	42
7.1	General	43
	7.1.1. Geometric Improvements	43
	7.1.2. Strengthening of Existing Pavements	43
7.2.	Improvement Proposal for Carriageway	44
7.3.	Improvement Proposal for Side Drains	45
7.4.	Improvements Related to utility, Road Furniture and appurtenances	45
8	**COST ESTIMATES**	46
8.1	Detailed Cost Estimate	47
8.2	General	47
8.3	Basic rates	47
8.4	Utility Relocation	47
8.5	Project Management and Quality Control	47

8.6 Project Cost 48

9. DETAILED ESTIMATES

10. DRAFT TENDER SCHEDULE

ANNEXURES

- **TYPICAL CROSS SECTION**
- **ROAD PHOTOGRAPHS**
- **WARD MAP**
- **KEY MAP**

INTRODUCTION

CHAPTER – 1

INTRODUCTION

Detailed Project Report

1.1 General

India's pride, Bengaluru is nearly 500 years old and has grown from a small time settlement when KempeGowda, the architect of Bengaluru, built a mud fort in 1537 and his son marked the city boundaries by erecting four watch towers. Bangalore is the capital and the largest city of Karnataka. It is also called "Garden City" for its beautiful gardens, flowers and trees which flourish in each and every street. Bangalore is India's third largest city, fifth most populous city and fifth-most populous urban agglomeration. The majority of the city of Bangalore lies in the Bangalore Urban district of Karnataka and the surrounding rural areas are a part of the Bangalore Rural district. In recent days Bangalore has transformed itself from a "pensioners' paradise" to a modern thriving "cosmopolitan metropolis". Today Bengaluru has grown well beyond those four towers into a sprawling metropolis of more than 6 million people and is referred to as the "Silicon Valley" of India.

As a large and growing metropolis, Bangalore is home to many well-recognized colleges and research institutions in India. Numerous public sector heavy industries, software companies, aerospace, telecommunications, and defence organizations are located in the city. Bangalore is also well known as a hub for India's Information Technology sector. It is among the top 10 preferred entrepreneurial locations in the world. Bangalore is a major economic and cultural hub and the second fastest growing major metropolis in India. Today 35 percent of India's software export is done at Bangalore. Rapid population growth in Bangalore was brought about by the IT and other associated industries, leading to an increase in the population to about 1.5 million, with an annual growth rate of 10-14%.every year.

Bangalore today is obviously one of the most sought after cities in the country with the rapid growth in the IT industry and other associated industries the rise in the number of job opportunities in the city. With the rising population in the city there is also a corresponding increase in the number of vehicles in the city. Bangalore's vehicular traffic has increased

manifold, with 1.6 million registered vehicles in the city — the second highest for an Indian city, after New Delhi. Bangalore in particular is that there is very little scope for expansion of roads and the need to use existing roads for smoothmovement of vehicles is even more pronounced. It thus becomes mandatory for the administration to ensure better parking facilities. With the increase in population and the expansion of the city, the problem of connectivity of the populace has arisen. Quite obviously personalized modes of transport have grown at a tremendous rate and two wheelers along with the cars. The maintenance and construction of roads to address the growing traffic in the city has been a challenge to the BDA and the BBMP. Development of the city road infrastructure has revolved around imposing one-way traffic in certain areas, improving traffic flow in junctions, constructing ring roads, bridges, flyovers and other grade separators.

Bangalore's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets. The city road network is mainly radial, converging in the centre. Many of Bangalore's erstwhile colonial and town streets were developed into commercial and entertainment areas after independence. The B.V.K Iyengar Road became the retail hub of Bangalore, while MG Road, Commercial Street and Brigade Road became important shopping, recreation and corporate areas. But for MG Road, other roads in and around the erstwhile Parade Ground remain narrow, winding roads. The unplanned nature of growth in the city resulted in massive traffic gridlocks that the municipality attempted to ease by constructing a flyover system and by imposing one-way traffic systems. Some of the flyovers and one-ways mitigated the traffic situation moderately but were unable to adequately address the disproportionate growth of city traffic. Some of the flyovers and one-ways mitigated the traffic situation moderately; however the volume of traffic continues to grow at an annual rate of between 7- 10%. The Outer Ring Road was initially constructed to ease truck congestion in the city; however the growth of suburbs reduced the positive impact of the ring road. BDA is laying additional lanes on many of the major roads around Bangalore. The Peripheral Ring Road is designed to be concentric to the Outer Ring Road and covers 108.9 km. The Hosur Road, which connects Bangalore to the Electronics City, is heavily congested and is part of the National Highway (NH7), therefore witnesses' heavy truck traffic as well.

Export Promotional Industrial Park (EPIP) in Bangalore is the place which entrepreneurs love to be identified with. EPIP is in the just next door of M/s ITPL, an internationally acclaimed technology park promoted by KIADB with TATAs and Singapore consortium of industries. This park comes with state-of-the-art infrastructure facilities. Following are the few of many features of this prestigious location

- Location in unpolluted, lush green atmosphere, just 17 Kms. from the heart of the city and 9 Kms. from Bangalore Airport.
- Total extent of developed land is 547 acres with well-laid asphalted roads & drainage systems.
- Assured water supply & dedicated power lines with Sodium Vapor street lighting.
- KTPO Exhibition Complex coming up in the area. Hospital with ultra modern facilities and well-equipped inland container depots.
- Well connected with public transport with host of secondary infrastructure facilities like telephones, Posts & Telegraph, Banks, ATMs, Convention center, Cafeterias, Travel operators.

EPIPs are the destination for industrial units who have plans to export at least 33% of their output in value offshore. These parks come with well-planned infrastructure, which is hallmark of KIADB's service. These parks are established with the sanction of Union Govt. of India to give impetus to growth of exports in the state. Government of Karnataka offers host of incentives and concessions to export oriented units.

The Bruhat Bengaluru Mahanagara Palike (BBMP, Greater Bangalore Municipal Corporation vide Government of Karnataka Notification no. UDD 92 MNY dt: 2.11.2006) is in charge of the civic administration of the city. It was formed in 2007 by merging 100 wards of the erstwhile Bangalore Mahanagara Palike, with seven neighboring City Municipal Councils (Rajarajeshwari Nagara, Dasarahalli, Bommanahalli, Krishnarajapuram, Mahadevapura, Byatarayanapura and Yelahanka), one Town Municipal Council (Kengeri) and 111 villages around Bangalore. The BBMP Is run by a city council composed of 250 members, including 198 corporators representing each of the wards of the city. The BBMP

works with the Bangalore Development Authority (BDA) and the Agenda for Bengaluru Infrastructure and Development Task Force (ABIDe) to design and implement civic projects.

The BBMP has taken up an ambitious plan to upgrade Arterial & Sub Arterial Road network in these newly added areas of BBMP and Development, maintenance and management of high quality network in EPIP zone roads at Mahadevapura Zone, where the traffic intensity has increased significantly and to augment the capacity for safe, efficient and free flow of traffic. Roads in and around EPIP zones are being upgraded to arterial road standards which will result in enormous increase in the traffic. Tech city, a preferred choice of many global corporations to position their businesses. It has indeed been a challenge to the government agencies including the urban local bodies to meet up with these unprecedented demands and challenges of the global companies and its citizens demanding international class 'citizen services'.

The project consists of improvements to roads and drains, in wards 03 of Yelahanka Satellite Town Sub Division Constituency, which includes 43 roads. The existing roads need to be improved, since they are not in good condition and to avoid inconvenience to people living in these wards. The total length of all Drains in ward 03 is 8136.1m (8.136Km), the total length of all Asphalt Roads in Ward 03 is 2876.5m (2.876Km). The ward maps in which the respective roads are highlighted are enclosed with this report.

1.2 Topography

Bangalore is situated in the southeast of Karnataka, at an average elevation of 920m above mean sea level. It is positioned at 12.97°N, 77.56°E and covers an area of 2, 190 sq.km. Bangalore Urban District borders with Kolar District in the northeast, Tumkur District in the northwest, Mandya District in the southwest, Chamarajanagar District in the south and the neighboring state of Tamil Nadu in the southeast. The Bangalore Urban District is divided into three taluks; Bangalore North, Bangalore South, and Anekal. The Bangalore North taluk is a relatively level plateau, while the Bangalore South taluk has an uneven landscape with intermingling hills and valleys.

1.3 Project objective

- The main objective of the study is to establish the technical & economical viability of the project roads by rehabilitation, strengthening, asphalting, concrete including culverts and improvements of side drains of the existing roads.
- The detailed project study includes submission of the detailed project report for the project as per standards.

1.4 Outline of the project

The consultant is required to conduct various engineering Surveys, Investigate, Carry out Detailed Design and Viability of the project. **Prepare Detailed Project Report**, based on Detailed Design and Bill of Quantities.

1.5 Contents of Detailed Project Report

This Detailed Project Report is submitted in 8 chapters dealing with different aspect of the study of the project road.

Chapter description

1 Introduction
2 Socio-Economic Profile
3 Description of project
4 Methodology
5 Design Standards
6 Pavement Overlay design
7 Conclusion
8 Cost estimate

SOCIO-ECONOMIC PROFILE

CHAPTER - 2

SOCIO-ECONOMIC PROFILE

2.1. General

Bangalore also rendered Bengaluru is the capital of the Indian state of Karnataka. Located on the Deccan Plateau in the south-eastern part of Karnataka, Bangalore is India's third most populous city and fifth-most populous urban agglomeration. Bangalore is well known as a hub for India's information technology sector. It is among the top 10 preferred entrepreneurial locations in the world.

A succession of South Indian dynasties ruled the region of Bangalore until in 1537 AD, Kempe Gowda, a feudatory ruler under the Vijayanagara Empire established a mud fort considered to be the foundation of modern Bangalore. Following transitory occupation by the Marathas and Mughals, the city remained under the Mysore kingdom, which is now a part of the Indian state of Karnataka. Bangalore continued to be a cantonment of the British and a major city of the Princely State of Mysore which existed as a nominally sovereign entity of the British Raj. Following the independence of India in 1947, Bangalore became the capital of Mysore state, and remained capital when the new Indian state of Karnataka was formed in 1956.

As a large and growing metropolis, Bangalore is home to many well recognized colleges and research institutions in India. Numerous public sector heavy industries, software companies, aerospace, telecommunications, and defence organisations are located in the city. Bangalore is known as the Silicon Valley of India because of its position as the nation's leading IT exporter. A demographically diverse city, Bangalore is a major economic and cultural hub and the second fastest growing major metropolis in India.

2.2. Geography

Bangalore lies in the southeast of the South Indian state of Karnataka. It is in the heart of the Mysore Plateau (a region of the larger Precambrian Deccan Plateau) at an average elevation of 900 m (2,953 ft).It is located at WiklMlniAtlas 12°58'N 77°34'E / 12.97°N 77.56°E /

12.97; 77.56 and covers an area of 741 sqkm (286 mi^2). The majority of the city of Bangalore lies in the Bangalore Urban district of Karnataka and the surrounding rural areas are a part of the Bangalore Rural district. The Government of Karnataka has carved out the new district of Ramanagara from the old Bangalore Rural district.

The topology of Bangalore is flat except for a central ridge running NNE-SSW. The highest point is Vidyaranyapura Doddabettahalli, which is 962 m (3,156 ft) and lies on this ridge. No major rivers run through the city, though the Arkavathi and South Pennar cross paths at the Nandi Hills, 60 km (37 mi.) to the north. River VrishabhavathI, a minor tributary of the Arkavathi, arises within the city at Basavanagudi and flows through the city. The rivers Arkavathi and Vrishabhavathi together carry much of Bangalore's sewage. A sewerage system, constructed in 1922, covers 215 km^2 (133 mi^2) of the city and connects with five sewage treatment centres located in the periphery of Bangalore.

2.3. Climate

Bangalore experiences a tropical savanna climate with distinct wet and dry seasons. Due to its high elevation. Bangalore usually enjoys a more moderate climate throughout the year, although occasional heat waves can make things very uncomfortable in the summer. The coolest month is December with an average low temperature of 15.4 °C and the hottest month is April with an average high temperature of 32.8 °C. The highest temperature ever recorded in Bangalore is 38.9°C(recorded in March 1931) and the lowest ever is 7.8 °C (recorded in January 1884). Winter temperatures rarely drop below 12 °C (54 °F), and summer temperatures seldom exceed 34-35 °C (<100 °F). Bangalore receives rainfall from both the northeast and the southwest monsoons and the wettest months are September, October and August, in that order. The summer heat is moderated by fairly frequent thunderstorms, which occasionally cause power outages and local flooding. The heaviest rainfall recorded in a 24 -hour period is 179 millimetres (7.0 in) recorded on 1 October 1997.

2.4. Transport

2.4.1. Air

Bengaluru is served by the Bengaluru International Airport which started operations from 24 May 2008. The new Bengaluru International Airport is located in Devanahalli. The city was earlier served by the HAL Airport which was India's fourth busiest airport. It is now the fourth busiest airport in India in terms of passenger traffic and the number of air traffic movements (ATMs) with about 280 per day. The airport is around 40 km from the city centre. The most hassle-free way to commute is by taxi. Meru cabs and Easy cabs have taxis present in the rank at the airport. There are also certain private cab companies.

2.4.2. Rail

A rapid transit system called the Namma Metro is being built. A 7 km stretch from Bayappanahalli to MG Road was opened to public on 20 October 2011. Once completed, this will encompass a 42.3 km (26.3 mi) elevated and underground rail network comprising 41 stations. It is expected to connect central locations in Bangalore to Devanahalli and the Chikballapur regions. This much-delayed project is the city's primary response to the worsening intra-city transport infrastructure which has become a major deterrent to continued business growth. Bengaluru comes under the South Western Railway zone of the Indian Railways Bangalore City Railway station and Yesvantpur Junction connects it to the rest of the country through the Indian Railways. The Bangalore Rajdhani Express connects the city to New Delhi, the capital of India. Bangalore is also connected by rail to most cities in Karnataka, as well as Mumbai, Chennai, Kolkata, Hyderabad, Indore, Mysore, Bhagalpur, Tatanagar, Trivandrum, Bhopal, and other major cities in India. The sprawling Rail Wheel Factory is Asia's second largest manufacturer of Wheel & Axle for Railways and headquartered in Yelahanka, Bangalore.

2.4.3 Road

Three-wheeled, green and black auto-rickshaws, referred to As autos, are a popular form of transport. They are metered and can accommodate up to three passengers. Taxis, commonly

called City Taxis, are usually available only on call. Taxis are metered and are generally more expensive than auto-rickshaws. Busesoperated by Bangalore Metropolitan Transport Corporation (BMTC) are an important means of public transport available in the city, and are highly reliable. While commuters can buy tickets on boarding these buses, BMTC also provides an option of a bus pass to frequent users. BMTC runs air-conditioned luxury buses on major routes, and also operates shuttle services from various parts of the city to the Bengaluru International Airport. The Karnataka State Road Transport Corporation operates 6,918 buses on 6,352 schedules, connecting Bangalore with other parts of Karnataka as well as other states. The main bus depots that BMTC maintains are the Kempegowda Bus Station, locally known as "Majestic bus stand", Shantinagar Bus Depot, and Shivajinagar Bus Depot.

2.5. Economy

Bengaluru's 52,346 crore (US$9.47 billion) economy (2006-07 Net District Income) makes it one of the major economic centres in India, with the value of city's exports totalling 43,221crore (US$7.82 billion) in 2004-05. With an economic growth of 10.3%, Bengaluru is the second fastest growing major metropolis in India, and is also the country's fourth largest fast moving consumer goods (FMCG) market. The Forbes magazine considers the city as one of "The Next Decade's Fastest- Growing Cities". With a per capita income of Rs.74,709 (US$1,352.23) in 2006-07, the city is the third largest hub for high net worth individuals and is home to over 10,000 dollar millionaires and about 60,000 super-rich people who have an investable surplus of Rs. 4.5 crore (US$1 million) and Rs. 50 lakh (US$ 90,500) respectively.

The headquarters of Infosys, India's third largest IT Company, is located in Bengaluru The headquarters of several public sector undertakings such as Bharat Electronics Limited (BEL), Hindustan Aeronautics Limited (HAL), National Aerospace Laboratories (NAL), Bharat Heavy Electricals Limited (BHEL), Bharat Earth Movers Limited (BEML) and HMT (formerly Hindustan Machine Tools) are located in Bangalore. In June 1972 the Indian Space Research Organisation (ISRO) was established under the Department of Space and headquartered in the city.

Bengaluru is called the Silicon Valley of India because of the large number of information technology companies located in the city which contributed 33% of India's Rs. 144,214 crore (US$ 26 billion) IT exports in 2006-07. Bangalore's IT industry is divided into three main cluster Software Technology Parks of India (STPI); International Tech Park, Bangalore (ITPB); and Electronics City. UB City, the headquarters of the United Breweries Group, is a high-end Commercial zone.[61] Infosys and Wipro, India's second and fourth largest software companies are headquartered in Bangalore, as are many of the global SEI-CMM Level 5 Companies.

The growth of IT has presented the city with uniqué challenges. Ideological clashes sometimes occur between the city's IT moguls, who demand an improvement in the city's infrastructure, and the state government, whose electoral base is primarily the people in rural Karnataka. The encouragement of high-tech industry in Bangalore, for example, has not favoured local employment development, but has, instead, increased land values and forced out small enterprise. The state has also resisted the massive investments required to reverse the rapid decline in intra-city transport which has already begun to drive new and expanding businesses to other centres across India. Bengaluru is a hub for biotechnology related industry in India and in the year 2005, around 47% of the 265 biotechnology companies in India were located here; including Biocon, India's largest biotechnology company.

2.6. Karnataka State Economy

Karnataka is one of the high economic growth states in India with the GSDP (Gross State Domestic Product) at constant prices growth of 8.9% in the fiscal year 2010-2011. Karnataka is the seventh largest GDP producing states in India. The State GSDP is expected to grow at 6.4% in 2011-12 which is slightly less than India's GDP estimate of 6.9% for the period. Per capita GSDP during 2010-2011 was Rs 47310 at constant prices. Karnataka is best known for its software industry and now biotechnology and the state has recorded the highest growth rates in terms of GDP and per capita GDP in the last decade compared to other states. In the last decade, Karnataka surpassed all other states in India, pushing Karnataka's per capita income in Indian Rupee terms to sixth place.

The contribution of primary, secondary and tertiary sectors to Karnataka's GSDP (at 2004-05 constant prices) in 2010-11 has been 16.06%, 28.48% and 55.35% respectively. The sectoral composition of Karnataka GSDP is comparable with sectoral composition of India's GDP of 14.4 % (Primary), 27.9% (Secondary) and 57.7 % (Tertiary sector). Between 2005-06 and 2010-11, average growth rate of Karnataka GSDP is 8.6 % which is same as India's GDP growth during the period. However, in the first three years that is from 2005-06 to 2007-08 the state GSDP has averaged 11.5 % with highest growth rate of 12.9% in 2007—08. But in the last three years from 2008-09 to 2010-11 the growth in GSDP has averaged only 5.7 %. Karnataka is the anufacturing hub for some of the largest public sector industries in India, including Hindustan Aeronautics Limited, National Aerospace Laboratories, Bharat Heavy Electricals Limited, Indian Telephone Industries, Bharat Earth Movers Limited and Hindustan Machine Tools, which are based in Bangalore. Many of India's premier science and technology research centers, such as Indian Space Research Organization, Central Power Research Institute, Bharat Electronics Limited and the Central Food Technological Research Institute, are also headquartered in Karnataka. Mangalore Refinery and Petrochemicals Limited is an oil refinery located in Mangalore.

2.7. Contribution to economy by sector

Karnataka has natural advantages that serve it well for diversified agricultural production. Agriculture and allied sectors in Karnataka grew in 2009-10 by 3.4 % and 12.9% in 2010-11. In the year 2011-12, the sector is expected to grow at a rate of -3.9% having affected by a severe drought. Karnataka has been credited by the Planning Commission for presenting separate agriculture budget.

Karnataka is the largest producer of coarse cereals, coffee and raw silk among the states in India. The income generated from horticulture constitutes over 40% of income generated from agriculture and it is about 17% of the state's GDP. In floriculture, Karnataka occupies the second position in India in terms of production. Silk industry is concentrated mainly in the North Bangalore regions of Muddenahalli, Kanivenarayanapura and Doddaballapura.

Gold, iron ore, quartz, limestone, manganese, kyanite and bauxite are some of the minerals that are found in Karnataka. Major mines of manganese and iron ore are located at Sandur in Bellary district.

Karnataka leads the nation in information technology and Biotechnology. Bangalore is the home of the largest bio cluster in India with total revenues of over Rs. 14 billion and having 158 of the 320 companies working on biotechnology in India.

Karnataka has a headcount of over 6800 scientists involved in biotech research. Capital Bangalore is well known as a hub for India's information technology sector. Large number of information technology companies located in the city which contributed 33% of India's Rs. 144,214 crore (US$ 32 billion) IT exports in 2006-07. Infosys and Wipro, India's second and third largest software companies are headquartered in

The state is home to some of the premier educational and research institutions of India such as the Indian Institute of Science, the Indian Institute of Management, the National Institute of Technology Karnataka and the National Law School of India University. The State boasts of the largest concentration of higher educational institutions like Medical and Engineering colleges. Apart from Bengaluru places like Belagavi (Belgaum), Mangalore, Mysore, Hubli-Dharwad and Davangere have been producing professionals for IT industry.

Karnataka, with a geographical area of 1, 91,791 sq.kms, is the eighth largest state of India, accounting for 5.83 % of the total area of the country. It is situated in the southern part of the country and is surrounded by the states of Maharashtra and Goa in the north and the northwest, Arabian Sea in the west, Tamil Nadu and Kerala in the south and Andhra Pradesh in the east. Administratively, the state has been divided into 27 districts, which are further sub-divided into tehsils and development blocks. Karnataka is endowed with a variety of physiographic features ranging from cool blue seas, verdant forests, breathtaking waterfalls and an endless stretch of plains and rolling hills that are about to touch the sky.

2.8. Economic Situation

The broad social and economic profile of the state during the past decade has undergone tremendous change. State Domestic Product (SDP), popularly known as 'State Income', is an important and reliable indicator to measure the growth of the economy as well as level of development in various socio-economic sectors of a state. The per capita Net State Domestic Product is used to determine the absolute as well as the relative performance of the State Economy. In other words State Domestic product (SDP) and Per Capita Income (PCI) reflect overall performance of economy of the State and also the well being of the people during a given period of time.

DESCRIPTION OF PROJECT ROADS

CHAPTER - 3

DESCRIPTION OF PROJECT ROADS;

3.1 General

The project consists of bad roads in Ward No.03, Yelahanka Satellite Town Sub Division Constituency, which includes 43 roads in. The existing roads need to be improved since there are formation of Cracks, Rutting and Potholes which are a hindrance to the free movement of traffic, in turn causing inconvenience to the people of the respective wards. The total length of all Drains in ward 03 is 8136.1 m (8.136 Km), The total length of all Asphalt Roads in Ward 03 is 2876.5m (2.876Km), Majority of roads pass through residential and commercial area. Below are the lists of the bad roads in their respective wards.

- **List of Roads**
- **List of Roads in Ward No. 03 (Deo Marvel Layout)**

- Deo Marvel Layout - 4th Cross Road (W0143)
- Deo Marvel Layout - 3rd Main Road (W0088)
- Deo Marvel Layout - 4th Main Road
- Deo Marvel Layout - 5th Cross Road (W0147)
- Deo Marvel Layout - 3rd Main 3rd Cross Road (W0157)
- Deo Marvel Layout - 2nd Main Road (W0090)
- Deo Marvel Layout - 3rd Main 2nd Cross Road (W0171)
- Deo Marvel Layout - 4th Main 6th Cross Road (W0137)
- Deo Marvel Layout - 4th Main 7th Cross Road (W0135)
- Deo Marvel Layout - 4th Main 8th Cross Road (W0133)
- Deo Marvel Layout - 4th Main 9th Cross Road (W0129)
- Deo Marvel Layout - 4th Main 10th Cross Road (Wo125)
- Deo Marvel Layout - 4th Main 11th Cross Road (W0119)
- Deo Marvel Layout - 4th Main R12th Cross Road (W0113)
- Deo Marvel Layout - 4th Main 13th Cross Road (W0103)
- Mahagani Street (W0131)

Restoration and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju layout, jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ward no -03 of Yelahanka New town Sub division (PACKAGE NO-13) (Number of Works-03)

- **List of Roads in Ward No. 03 (Jyothi Nagar)**
  - Jyothi Nagar- 1st Cross Road (W0446)
  - Jyothi Nagar- Cross Road
- **List of Roads in Ward No.03 (Muniraju Layout)**
  - Muniraju Layout- Main Road (WO294)
  - Muniraju Layout- 3rd Cross Road (WO521)
  - Muniraju Layout- 1st Cross Road (WO525)
  - Muniraju Layout- 1st Cross Road (WO525)
  - Muniraju Layout- 2nd Cross Road (W0523)
  - Muniraju Layout- 2nd Cross Road(W0523)
  - Muniraju Layout- 3rd Cross Road (WO521)
  - Muniraju Layout- 4th Cross Road (W0517)
  - Muniraju Layout- 4th Cross Road (W0517)
  - Sri Krishna Enclave
  - Patel Tayappa Layout
  - Raghavendra Medical Opposite Road (W0123)
  - Century Saras Road (W0128)
- **List of Roads in Ward No.03 (Sai Nagar Phase-1)**
  - Sai Nagar Phase-1- 1st Cross Road (W0562)
  - Sai Nagar Phase-1- 2nd Cross Road (W0556)
  - Sai Nagar Phase-1- 3rd Cross Road (WO554)
  - Sai Nagar Phase-1- 4th Cross Road (WO 440)
  - Sai Nagar Phase-1- Sai Baba Temple Road (WO793)
  - Sai Nagar Phase-1- # 61 Maathru Sri Nilaya (WO434)
  - Sai Nagar Phase-1- Sai Mandir Left Side Road
  - Sai Nagar Phase-1- Sai Mandira Right
- **List of Roads in Ward No.03 (Sai Nagar Phase-III)**
  - Sai Nagar Phase-III- 3rd Cross Road (W0785)
  - Sai Nagar Phase-III- 4th Cross Road (W0779)

- Lakshmi Poly Clinic
- Dillenia Street (W0127)

3.2 Existing project roads

3.2.1 Terrain

Terrain is classified by general slope of the country across the alignment, based on this criterion majority of the project roads pass through Plain terrain.

3.2.2 Alignment

The existing roads have the carriage widths varying from 3.8 m to 9.3 m and and the existing gradients of the project roads are within acceptable limits as per IRC: 86. Table 1 shows the list of project roads with their carriage way widths.

3.2.3 Climate

Due to its elevation, Bangalore enjoys a pleasant climate throughout the year, with temperatures ranging between 33°C and 16°C, with an average of 24°C. The summer heat is moderated by occasional thunderstorms and squalls. Bangalore receives adequate rainfall of about 860 mm from the Northeast Monsoon as well as the Southwest Monsoon. The wettest months are August, September and October.

3.2.4 Carriageway Width

The existing carriageway width varies from 3.8 m to 9.3 m and. Details of carriageway width are as shown in Table 3.1 below.

Table 3.1 - LIST OF ROADS WITH THEIR CARRIAGE WAY WIDTHS

Sl No	Name of the Road	Carriage Way Width in m
	Muniraju Layout	
1	Main Road (WO294)	7.00
2	3rd Cross Road (WO521)	5.40
3	1st Cross Road (WO525)	6.00

4	1st Cross Road (WO525)	5.80
5	2nd Cross Road (W0523)	5.50
6	2nd Cross Road(W0523)	5.00
7	3rd Cross Road (WO521)	5.70
8	Sri Krishna Enclave	3.90
9	Patel Tayappa Layout	6.40
10	Raghavendra Medical Opposite Road (W0123)	9.30
11	Century Saras Road (W0128)	8.90
	Sai Nagar Phase-1	
12	1st Cross Road (W0562)	7.10
13	2nd Cross Road (W0556)	6.50
14	3rd Cross Road (WO554)	6.50
15	4th Cross Road (WO 440)	6.70
16	Sai Baba Temple Road (WO793)	6.70
17	# 61 Maathru Sri Nilaya (WO434)	5.10
18	Sai Mandir Left Side Road	5.20
19	Sai Mandira Right	5.10
	Sai Nagar Phase-III	
20	3rd Cross Road (W0785)	5.50
21	4th Cross Road (W0779)	6.90
22	Lakshmi Poly Clinic	5.50
	Jyothi Nagar	
23	1st Cross Road (W0446)	6.70
24	Cross Road	3.80
	Muniraju Layout	
25	4th Cross Road (W0517)	5.80
26	4th Cross Road (W0517)	5.50
	Ramanashree California Garden (Ananthpura)	
27	Dillenia Street (W0127)	7.40

3.2.5 Pavement Condition

The existing pavement conditions are analyzed based on visual inspection as per IRC 81-1997 Table -1. The Roads as per the Visual Inspection were found to be in Good to Poor condition. This may be due to improper material in subgrade, compaction or movement of heavily loaded trucks. The summaries of pavement condition obtained by visual inspection are listed in Table 3.2 below

TABLE 3.2: PAVEMENT CLASSIFICATION BASED ON VISUAL INSPECTION

Sl No	Name of the Road	Road Condition
	Muniraju Layout	
1	Main Road (WO294)	Poor
2	3rd Cross Road (WO521)	Poor
3	1st Cross Road (WO525)	Poor
4	1st Cross Road (WO525)	Poor
5	2nd Cross Road (W0523)	Poor
6	2nd Cross Road(W0523)	Poor
7	3rd Cross Road (WO521)	Poor
8	Sri Krishna Enclave	Poor
9	Patel Tayappa Layout	Poor
10	Raghavendra Medical Opposite Road (W0123)	Poor
11	Century Saras Road (W0128)	Poor
	Sai Nagar Phase-1	
12	1st Cross Road (W0562)	Poor
13	2nd Cross Road (W0556)	Poor
14	3rd Cross Road (WO554)	Poor
15	4th Cross Road (WO 440)	Poor
16	Sai Baba Temple Road (WO793)	Poor
17	# 61 Maathru Sri Nilaya (WO434)	Poor
18	Sai Mandir Left Side Road	Poor
19	Sai Mandira Right	Poor
	Sai Nagar Phase-III	
20	3rd Cross Road (W0785)	Poor
21	4th Cross Road (W0779)	Poor
22	Lakshmi Poly Clinic	Poor
	Jyothi Nagar	
23	1st Cross Road (W0446)	Poor
24	Cross Road	Poor
	Muniraju Layout	
25	4th Cross Road (W0517)	Poor
26	4th Cross Road (W0517)	Poor
	Ramanashree California Garden (Ananthpura)	
27	Dillenia Street (W0127)	Poor

3.2.6 Land Use along the project highway

Land use along majority of roads is predominantly for built up area. The settlements are used for residential and commercial purposes.

3.3 Traffic flow conditions

Traffic on these project roads is of mixed type. Majority of roads only carry passenger vehicle most of the time, and there are also commercial vehicles ply on some roads. Commercial vehicles include 2-axle and 3-axle trucks and LCVs.

The intensity of traffic on this stretch is likely increase in future, the reason being:

- The Bangalore Mahanagara Palike became Bruhat Bangalore Mahanagara Palike after inclusion of 7 CMC, 1TMC & 111 Villages adjoining to the CMC areas vide Government of Karnataka Notification No. UDD 92 MNY 2006 dated 02.11.2006. To provide better transport facility, to improve the quality of urban civic services better roads are needed. At present the existing roads in these newly added areas are narrow without proper Drainage, Footpath, and Culverts etc. The BBMP has taken up an ambitious plan to upgrade Arterial & Sub Arterial Road network in these newly added areas of BBMP in view of providing better infrastructure.
- Roads in and around EPIP zones are being upgraded to arterial road standards which will result in enormous increase in the traffic.
- The number of commercial and residential plots in the given area is high.
- Rising traffic congestion is one of the key issues in the City. Though the length of roads available is good, the problem lies with the restricted widths.

3.4 Cross Drainage Structures and Side Drains

There are no major CD structures along the project road except for the cross roads. The condition of the existing CD structures is good.

3.5 Utilities

- **HT Lines**

  HT lines do not cross along the project roads

- **Light Poles**

  Large numbers of light poles are present along the project roads in regular intervals

3.6 Trees

The project roads consist of trees beside the carriageway at regular intervals. Also tree pits are constructed for all the trees on either side of the roads for watering the trees. Curb stones are laid all round the tree pits for protection

METHODOLOGY

CHAPTER - 4

METHODOLOGY ADOPTED FOR FEASIBILITY STUDY

4.1 General

The main objective of the feasibility study is to establish the technical, economical and financial viability of the project by conducting field surveys, investigations, analysis and by working out detailed costs of the project. The methodology adopted in preparing the feasibility study report is discussed in subsequent sections.

Brief details of surveys and investigations carried out for the preparation of this report is discussed in subsequent sections and the results are used in the preparation of this report.

4.2 Reconnaissance survey

Reconnaissance of the project road has been carried out for the entire length of the project road by a team of key personnel and support staff. The details have been collected as per IRC-SP: 19. The details collected during reconnaissance from the site are used in carrying out the detailed field surveys, preparation of linear strip plan. The relevant data viz. pavement/shoulder width, altitude, rainfall and existing pavement composition have been used as input data for cost estimate.

4.3 Road Inventory Survey

Detailed inventory of entire road stretch has been carried out by the Engineers of the consultant's team through dimensional measurement and visual inspection by making use of well-structured inventory data collected during the road inventory broadly include:

- Terrain
- Carriageway Type and width
- Shoulder Type and width
- Footpath type and width
- Drain type and width
- Details of Junctions

- Land Use Type on either side of the road section
- Road Geometry
- Utility Data
- Trees
- Soil Type
- Existing Bus Stops/ Bus Shelters

All the above information has been compiled and presented in the form of Annexure for easy understanding. Data captured with respect to road geometry has been made use of to identify the curve locations where there is a scope for improvement in road geometry.

4.4 Pavement Condition Survey

4.4.1 Visual Condition Survey

Visual condition survey of the entire project road have been carried out by travelling along the project road and noting down the pavement condition such as extent of cracking (cracks of less than 3mm, cracks wider than 3mm & transverse cracks), patching, rutting, pot holes etc., by visual observations in a well structured data format for every 25m interval using the distress criteria.

4.4.2 Pavement Structural Strength

Benkelman Beam Deflection (BBD) survey is carried out for pavement structural strength investigations. The beam is calibrated before commencement of field work as per IRC: 81 - 1997.

The methodology adopted is the CGRA method in accordance with IRC; 81 -1997. This method of test covers a procedure for the determination of the rebound deflection of pavement under static load of the rear axle of a standard truck. A five tonne truck with 8710 kg rear axle load equally distributed over two rear axle, and tyre's inflated to a pressure of 5.6 Kg/cm^2, is used for loading the pavement.

The deflection test was carried out in accordance with IRC: 81 - 1997. BBD readings were taken along the left lane left wheel path at 0.6m from pavement edge at all locations of pavement. However, points are selected in such a manner that they do not fall on widened portion of the pavement. Readings were taken at 50m interval. Adjustments to reading locations were made in order to avoid culverts, bridge decks and locally damaged areas. The readings were taken at intervals on 0.0m, 2.7m and 11.7m. Special attention was given for recording the dial gauge reading.

The dial gauge least count is 0.01mm. Deflection readings were recorded on data sheets as per IRC guidelines. The rebound deflection values obtained in each stretch were used to calculate the statistical parameters, mean and standard deviation. Temperature correction was applied as per the recommendations of IRC: 81 - 1997 as the pavement temperature was higher than the standard temperature of 35°C.

The moisture content tests, liquid limit tests and plastic limit tests were done in the laboratory and accordingly, moisture content correction was applied to the observed deflection values as per the guidelines In IRC: 81 - 1997. The characteristic deflection is taken as mean plus standard deviation. The deflection values are used in working out the flexible overlay thickness in terms of Bituminous Macadam. The equivalent thickness of DBM & BC is determined based on the equivalency factor mentioned in the IRC: 81 - 1997.

BBD survey has not been carried out in badly damaged sections. The existing pavement layers show variation in quality and thickness. The corrected BBD readings are used in the design of overlay thickness on existing flexible pavement.

The Benkelman Beam deflection data obtained as per IRC: 81 - 1997 were analyzed. The raw data consisted of initial, intermediate and final deflection values at equal intervals. The BBD test has been carried out on one major project road in each Ward. The characteristic deflection values and equivalent overlay thickness worked out are mentioned in the Table 4.1. The test details are enclosed in annexure.

4.5 Pavement Composition

Pavement Composition of project roads is carried out at five important roads in each ward by digging test pits 1m X 1m X 0.8m at the edge of the existing pavement. Existing pavement composition viz. bituminous course, base and subgrade type and their thicknesses are noted. The above particulars recorded at each location are shown in the Table 4.2

TABLE 4.2: PAVEMENT COMPOSITIONS OF MAJOR ROADS IN WARDS 03

Sl.No	Name of the road	Pavement Composition	
		Bituminous layer in "mm	W.M.M in "mm"
Ward No.03			
1	1st Cross Road	40	200
2	5th Cross Road	40	200
3	1st Cross Road (W0562)	40	200
4	3rd Cross Road (W0785)	40	200
5	Patel Tayappa Layout	40	200

4.6 Sub grade Characteristics and Strength

1 test pit of size 1.0m x 1.0m x 0.8m was dug by the side of existing pavement edge. Pavement composition and their thicknesses are recorded from each pit. Subgrade soil sample of approx. 5kgs collected from the test pit for conducting following tests.

- Wet sieve analysis for soil classification
- Moisture content of Subgrade soil
- Atterberg limits to obtain plasticity index value

TABLE 4.3: TEST RESULTS OF SOIL SAMPLES

Sl.No	Name of the road	Soil Classification	NMC	Sieve Analysis			Atterberg Limits		
				Gravel %	Sand %	Silt & Clay %	LL %	PL %	PI %
	Ward No.03								
1	1st Cross Road	GM	15.61%	28.06	64.21	10.02	31.73	19.14	18.36
2	5th Cross Road	SW	17.93%	24.34	64.88	13.20	33.21	18.62	15.32
3	1st Cross Road (W0562)	GC	16.20%	40.62	23.88	38.27	32.66	18.08	15.71
4	3rd Cross Road (W0785)	GM	16.10%	27.77	63.45	11.33	34.50	19.01	17.86
5	Patel Tayappa Layout	SM	15.88%	25.78	62.78	15.10	36.17	17.88	19.12

4.7 Topographical survey

4.7.1 GPS stations

GPS control survey stations have been established at the start of the project road using dual frequency GPS equipment consisting of dual frequency antenna, sensor and controller. All the observed raw data is processed and the network is adjusted within the specified accuracy to get the final WGS coordinates.

4.7.2 Detailed topographic survey

Detailed topographic survey has been completed for the entire length of project road. The detailed topographic survey is carried out using electronic total station equipment of Leica make of 2 sec accuracy, taking reference coordinates from GPS/Traverse stations and elevation carried from bench marks on to traverse stations.

The following physical features are captured with in a survey corridor width of 24m or ROW width whichever is higher.

Cross section levels at 30m on straight reach and at 30m interval at curves. In addition road centre levels are taken at every 30m and spot levels at isolated high and depression points.

Detailed ground features upto existing fence, hedges, compound line are captured. Utilities like electric poles, light poles, telephone poles, OFCs, pipelines, transformers, hand pumps, boreholes, wells etc are captured. Side Drains, Trees and buildings along the project road within the survey corridor are captured. Cross roads are surveyed up to 50m length Inventory & condition survey of structures

4.7.3 Inventory of bridge and CD works and Culverts

There are no major CD structures and Culverts along the project roads

4.7.4 General Repairs to Side Drains

The Existing side drains were visually inspected and the following proposals are made for their rectification

- Desilting of existing drains
- Removal and resetting of damaged Cover slabs and curb stones
- Rectification of foot path

DESIGN STANDARDS

CHAPTER – 5

DESIGN STANDARDS, SPECIFICATIONS AND CROSS SECTIONS

5.1 Introduction

The design of Roads, pedestrian facilities and street furniture are essentially based on design standards. The design features/requirements are in accordance with the TOR and based on relevant IRC codes, MORT&H & BIS specifications. Whenever, the Codes/ Standards are silent on some of the aspects, the same has been planned / designed based on sound engineering practice.

Design Standards have been further detailed under the following heads.

Geometric Design

Pavement Design

Drainage

Road Furniture and Appurtenances

5.2 Design Standards for Geometric Design

Design Standards related to Road Geometric along with the suggested design values/standards and recommended values are based on Site conditions and data analysis is given In Table 5.1.

TABLE 5.1: GEOMETRIC DESIGN STANDARDS AS PER IRC: 86 - 1983 – "GEOMETRIC DESIGN STANDARDS FOR URBAN ROADS IN PLAINS"

SI No.	Design Parameters	Design Values
1	Design Speed	
	Arterial Road	80 kmph
	Sub - arterial Road	60 kmph

	Collector Street	50 kmph
	Local Street	630 kmph
2	Geometric Design Standards	
	Carriageway Width	Two lane carriageway without raised kerb - 7.0m
		Two lane carriageway with raised kerb - 7.5m
		Three lane carriageway with or without kerb
		10.5/11.0m
		Four lane carriageway with or without kerb- 14.0m
		Six lane carriageway with or without kerb – 21.0m
	Land Width	Arterial Road - 50 to 60m
		Sub Arterial Road - 30 to 40m
		Collector Street - 20 to 30m
		Local Street - 10 to 20m
	Median	Absolute Minimum Width - 1.2m
		Desirable Minimum Width - 5.0m
	Footpath	Minimum Width - 1.5m
	Camber	1.7 - 2.5 % for Paved Carriageway (Camber of 3% has been adopted to provide better Drainage and to reduce Profile Corrective Course Quantity).
	Kerb	Barrier / Semi - barrier / Mountable (Barrier type recommended)
	Super elevation	Limited to 4%
	Minimum Radius of	40 m for a speed of 30 kmph
	Horizontal Curve	105 m for a speed of 50 kmph
	Extra Widening at Curves	Nil for Radius above 300 m
	Gradient	Maximum Gradient - 4.0 % (1 in 25)

		Minimum Gradient for Drainage - 0.5% (desirable minimum) and 0.3 % (absolute minimum).

5.3 Design Standards for Pavement Design and Pavement Overlay Design

Design standards related to pavement design are essentially based on the guidelines given in IRC: 37 - 2012 "Guidelines for design of flexible pavements" and design standards related to overlay design are essentially based on IRC: 81 - 1997 "Guidelines for strengthening of flexible road pavements using Benkelman beam deflection technique". IRC: 58 - 2015 Guidelines for the design of Plain jointed rigid pavement for highways.The suggested design values / standards and recommended values based on site conditions and data analysis are detailed in Table 5.2 and are adapted in the Design.

TABLE 5.2: PAVEMENT DESIGN AND PAVEMENT OVERLAY DESIGN

SI. No.	Design Parameters	Reference Code / Design Values
1	Overlay Design	IRC; 81 - 1997 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique"
2	Design Life	10 years
3	Correction Factors	Temperature Correction Factor. Correction for Seasonal Variation (inclusive of Correction for Moisture Content, Soil Type and rainfall
4	Minimum Thickness	From Structural Considerations recommended minimum Bituminous Overlay Thickness is 40 mm BC (minimum) + 50mm DBM or 25mm SDBC+ 50mm DBM based on traffic.
5	Wearing Course	Bituminous Concrete with Crumb Rubber

	Material (Options)	Modified Bitumen / Plastic Waste.
6	Mastic Asphalt	Near Junctions/ over CD structures

5.4 Design Standards Related to Road Drainage

Drainage of Water from Pavement Surface is of paramount importance as far as preserving the Road Assets created by investing huge funds in addition to maintaining the Structural Soundness and functional efficiency of the road is concerned. Design Standards related to road drainage are essentially based on the guidelines given in IRC; SP; 42 – 1994 "Guidelines on Road Drainage" and in IRC: SP: 50 - 1999 "Guidelines on Urban Drainage". The suggested Design Values / Standards are detailed in Table 6.

TABLE5.3: DESIGN STANDARD RELATED TO ROAD DRAINAGE

SI. No.	**Design Parameters**	**Design Values**
1	Camber	1.7 - 2.5% (bi - directional) for Carriagew/ay (Camber of 3% is adopted).
	Longitudinal Gradient	Minimum 0.3 - 0.5% for satisfactory Drainage
2	Drain Type	Pre cast RCC Slab over existing SSM Drain. Pre cast RCC U - Box Drain with RCC Top Slab for Tertiary and Shoulder Drain. Cast - in - Situ RCC Drain with RCC Top Slab for Tertiary and Shoulder Drain. RCC Box Culverts across Cross Roads.

		BS Slab Drains with or without cover.

5.5 Design Standards Related to Utility, Road Furniture and Appurtenances

Utility and Importance of the Road are greatly enhanced by installing Road Furniture and Appurtenances at appropriate locations along the Project Road, which ensures Improved Road Safety. Planning and Design of Road Furniture and Appurtenances are as per the Guidelines stipulated in IRC. Detailing of each of these Components has been done so that to integrate the same with the Road Improvement Scheme. The suggested Design Values / Standards are detailed in Table 7

TABLE 5.3: DESIGN STANDARD RELATED TO ROAD UTILITY, ROAD FURNITURE AND APPURTENANCES

Sl. No.	Design Parameters	Reference Code / Design Values
1	Accommodation of Utility services	IRC: 98-1997 "Accommodation of utility services on Roads in urban areas"
2	Road Markings	IRC: 35- 1997 " Code of Practice for Road Markings".
3	Road Signs	IRC: 67 - 2001 " Code of Practice for Road Signs".
4	Road Delineators	IRC: 79 - 1981 " Recommended Practice for Road Delineators".
5	Pedestrian Facilities	IRC:103-1988 "Guidelines for Pedestrian Facilities".
6	Metal Beam Crash Barriers	At locations where embankment height is more tha n 3m

In addition to the above measures, various other Integral Road Components have been planned so that to achieve the Maximum and Optimal Use of the Carriageway with no / least

interference to Traffic Flow and at the same time ensuring adequate facilities to other road users especially Pedestrians. All the encroachments, if any shall be cleared within the ROW.

5.6 Material specifications

Materials specifications to be used in the construction of road and structures will be based on the MORT&H "Specifications for road and bridge works" (Fourth Revision) 2001 published by IRC. Wherever technical specifications are not available in MORT&H, manufacturer specifications reference will be made in detail.

PAVEMENT DESIGN

CHAPTER - 6

FLEXIBLE PAVEMENT DESIGN

6.1. Methodology

The purpose of the pavement design is to arrive at the most advantageous solution, considering all costs occurring during the life of the pavement, viz. construction costs, future maintenance costs and future costs for the road users.

6.1.1 Pavement Overlay Design

The Project Roads as listed in **Chapter-3** in Ward 03 there are various buildings, apartments and commercial complexes which are located on either sides of the roads. The Traffic surveys and forecasts reveals that the design traffic of 2 MSA may be assumed for the project roads and a 10 years design life is considered for pavement overlay Design. Based on the Visual inspection and investigation of important roads by digging out test pits it was found that the Sub Base and Base were not damaged and were in good condition. Hence the Existing surfaces shall be overlaid with 50mm Bituminous Mecadam and 40mm Bituminous Concrete.

The pavement overlay design methods adopted in the study are based on following design standards.

- IRC 81-1997 "Guidelines for strengthening of flexible road pavement using BBD Technique"

Design inputs required for the pavement design are established based on the requirements of standards and pavement investigations carried out along the project roads.

6.2. Pavement Investigations

6.2.1 Introduction

This section provides a summary of the results of the pavement investigations carried out along the project roads

The pavement investigations along existing road include:

- Test pit investigations
- Pavement Visual Condition Survey
- Benkelman Beam Deflection Measurement

6.2.2 Pavement Crust Details:

The existing pavement consists 200mm Water Bound Macadam (WBM) as wearing course and gravelly soil as subgrade.

6.2.3 Existing Subgrade Soil Classification

The soil samples of the subgrade collected from the test pits are tested in the laboratory and the soil characteristics viz. Grain size classification, Atterberg limits and compaction characteristics are determined as per IS : 2720 (part 8) details of which are mentioned in **Chapter 4.**

6.3 Computation of Design Traffic (As per IRC-37, 2012)

The design traffic is considered in terms of cumulative number of standard axels to be carried during the design life of the road. Its computation involves estimates of the initial volume of commercial vehicles per day, lateral distribution of traffic, the growth rate, the design life in years and the vehicle damage factor(Number of standard axel per commercial vehicle) to convert commercial vehicles to standard axels.

The following equation may be used to make the required calculation

$$N_s = \frac{365 \times [(1+r)^x - 1]}{r} \times A \times D \times F$$

N = Cumulative number of standard axles to be catered for in the design in terms of msa.

A = Initial traffic in the year of completion of construction in terms of the number of Commercial Vehicles Per Day (CVPD).

D = Lane distribution factor

F = Vehicle Damage Factor (VDF)

n = Design life in years.

r = Annual growth rate of commercial vehicles in decimal (e.g., for 5 per cent annual growth rate, r = 0.05).

CONCLUSION

CHAPTER - 7

CONCLUSIONS

7.1 General

The primary data collected from the site provides a clear picture of the site conditions, and also gives us a good insight about the deficiencies and the scope for improvements. The primary data coupled with the good engineering expertise lead us in giving apt and economical recommendations for the improvements. A budget of Rs. 11,00,00,000/- (Rs. Eleven Crore Only) has been allocated for this project. Hence, the provisions of items made in the cost estimate are in consensus with the allocated budget. The improvement proposal includes the following:

7.1.1. Geometric Improvements:

- Improvements of existing carriageway
- Improvements to cross sectional elements
- Improvements to horizontal alignment
- Improvements to longitudinal profile

7.1.2. Strengthening of Existing Pavements:

- ➢ Pavement Overlay design
- ➢ Road Drainage
- ➢ Road Furniture and Appurtenances
- ➢ Pedestrian Facilities
- ➢ Aesthetics

The summary of improvement proposals along the project roads in Wards 03 Conforming to Design Standards with all the Relevant Details such as Length and Width of existing roads, Plans and Construction Costs has been prepared. The details of improvement proposals are discussed in subsequent sections.

7.2. Improvement proposal for Carriageway

Since the majority of the roads are Arterial and sub-arterial roads where the Traffic intensity is less than 10msa, Table 7.1 shows the improvement proposals and pavement composition for the existing roads.

TABLE 7.1: IMPROVEMENT PROPOSAL AND PAVEMENT CONDITION DETAILS

FLEXIBLE PAVEMENT

Sl No	Name of the Road	BC (mm)
	Muniraju Layout	
1	Main Road (WO294)	40
2	3rd Cross Road (WO521)	40
3	1st Cross Road (WO525)	40
4	1st Cross Road (WO525)	40
5	2nd Cross Road (W0523)	40
6	2nd Cross Road(W0523)	40
7	3rd Cross Road (WO521)	40
8	Sri Krishna Enclave	40
9	Patel Tayappa Layout	40
10	Raghavendra Medical Opposite Road (W0123)	40
11	Century Saras Road (W0128)	40
	Sai Nagar Phase-1	
12	1st Cross Road (W0562)	40
13	2nd Cross Road (W0556)	40
14	3rd Cross Road (WO554)	40
15	4th Cross Road (WO 440)	40
16	Sai Baba Temple Road (WO793)	40
17	# 61 Maathru Sri Nilaya (WO434)	40
18	Sai Mandir Left Side Road	40
19	Sai Mandira Right	40
	Sai Nagar Phase-III	
20	3rd Cross Road (W0785)	40
21	4th Cross Road (W0779)	40
22	Lakshmi Poly Clinic	40

	Jyothi Nagar	
23	1st Cross Road (W0446)	40
24	Cross Road	40
	Muniraju Layout	
25	4th Cross Road (W0517)	40
26	4th Cross Road (W0517)	40
	Ramanashree California Garden (Ananthpura)	
27	Dillenia Street (W0127)	40

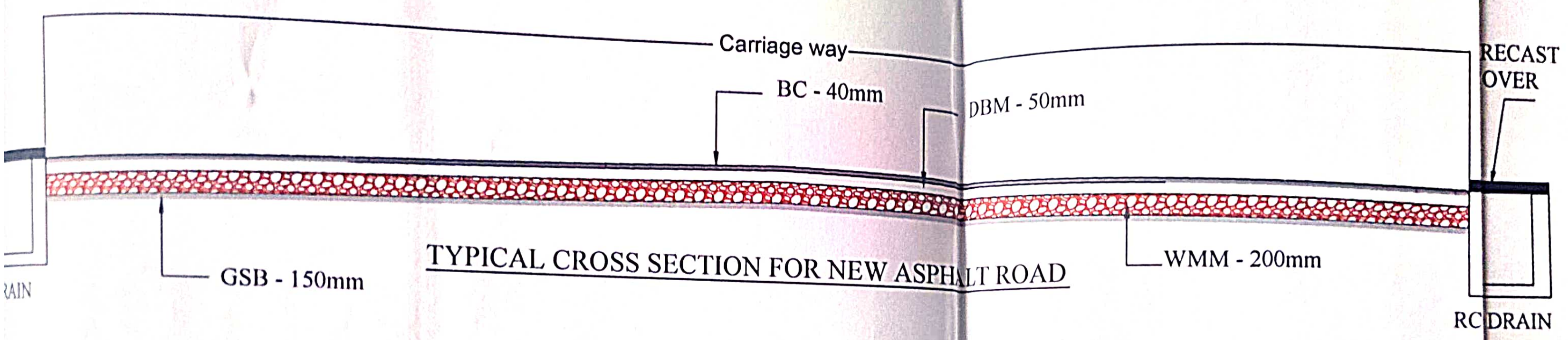
7.3. Improvement Proposal for Side Drains

Adequate drainage is a primary requirement for maintaining the structural soundness and functional efficiency of a road in addition to preserving the valuable road assets created. Pavement structure including subgrade must be protected from any ingress of water, otherwise over a period of time it may weaken the sub grade by saturating it and cause distress in the pavement structure. Hence, rapid dispersal of water from pavement and sub grade is a basic consideration in road design. Also, quick drainage takes away the water from pavement's surface and reduces chances of skidding of vehicles.

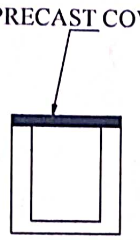
The requirements of road drainage are essentially based on IRC: SP-42-" Guidelines on Road Drainage" and IRC:SP-50 -"Guidelines on Urban Drainage". Camber of 3.0 is provided for the carriageway. For longitudinal drains, a minimum longitudinal gradient of 0.3 percent shall be ensured for satisfactory drainage.

7.4. Improvements Related to Utility, Road Furniture and Appurtenances

Utility and Importance of the Road are greatly enhanced by installing Road Furniture and Appurtenances at appropriate locations along the Project Road, which ensures Improved Road Safety. Planning and Design of Road Furniture and Appurtenances are as per the Guidelines stipulated in IRC. Detailing of each of these Components has been done so that to integrate the same with the Road Improvement Scheme.



TYPICAL CROSS SECTION FOR NEW ASPHALT ROAD



TYPICAL CROSS SECTION OF RCC DRAIN

1) Do Not Scale The drawing
2) All the Dimensions Are In MM

REV No	REV DATE	REMARKS
-	-	-

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PROJECT	Restoration and Improvements of [illegible] roads of [illegible] layout, [illegible] layout, [illegible] layout, [illegible] 1st main road, [illegible] layout, [illegible] phase-1 and surrounding areas in ward no 43 of [illegible] Sub division (PACKAGE NO-13) (Number of Works-[illegible])
CLIENT	B B M P
TITLE	TYPICAL CROSS SECTION OF ASPHALT ROAD
DESIGN	R. KARTHIK RECHAN
CHECKED	R. RUDRAPRASAD
DRAWN	AISHWARYA V
SCALE	NTS
REV.	R0

Restoration and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju layout, jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ward no -03 of Yelahanka New town Sub division (PACKAGE NO-13) (Number of Works-03)

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ಸಹಾಯಕ ಕಾರ್ಯಪಾಲಕ ಅಭಿಯಂತರರು
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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

...ation and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju ... Jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ...no -03 of Yelahanka New town Sub division (PACKAGE NO-13) (Number of Works-03)

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ಬೃ.ಬೆಂ.ಮ.ಪಾ. ಬೆಂಗಳೂರು-106

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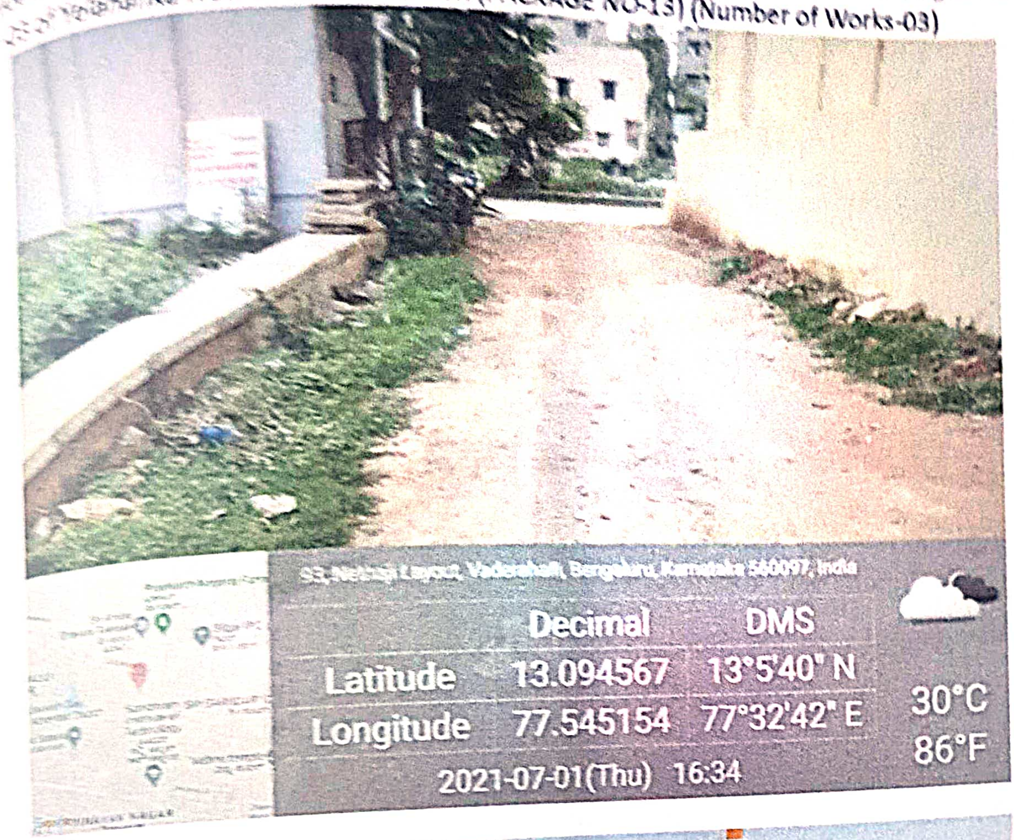

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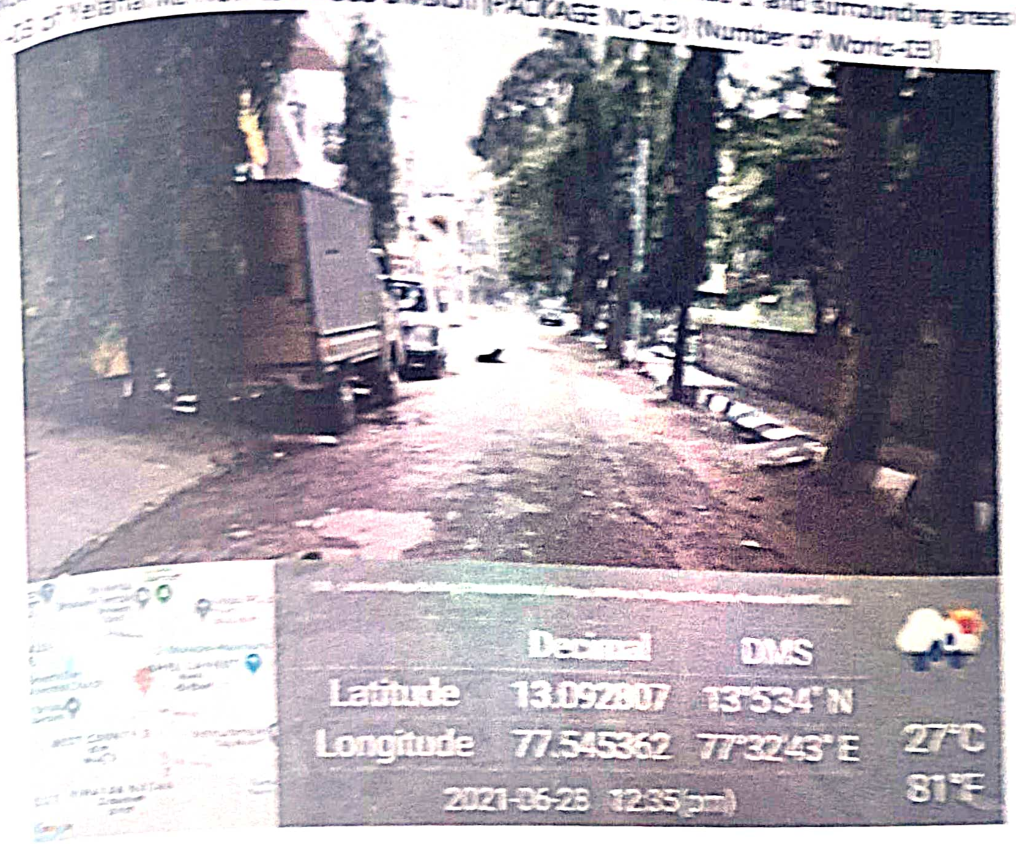

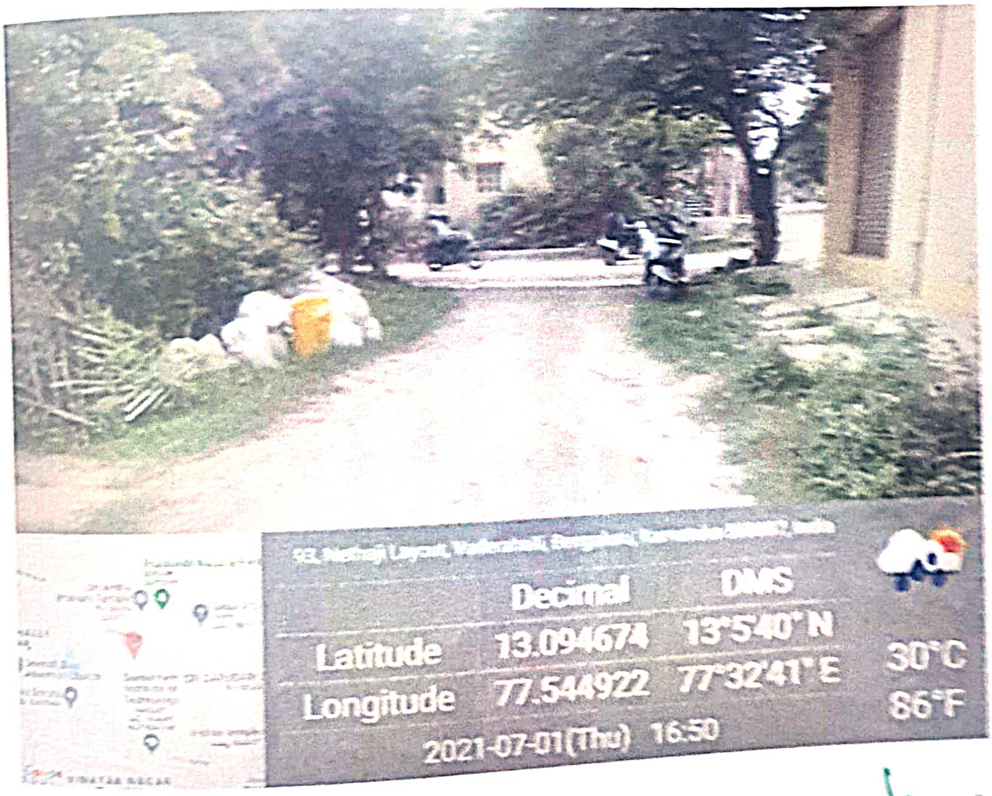

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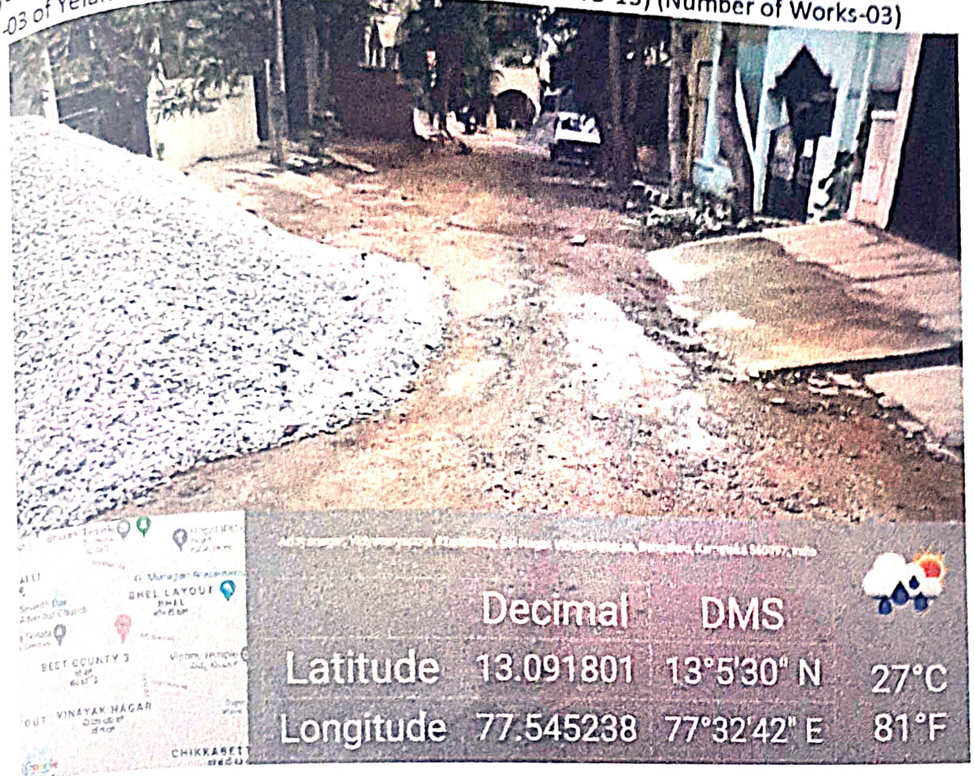

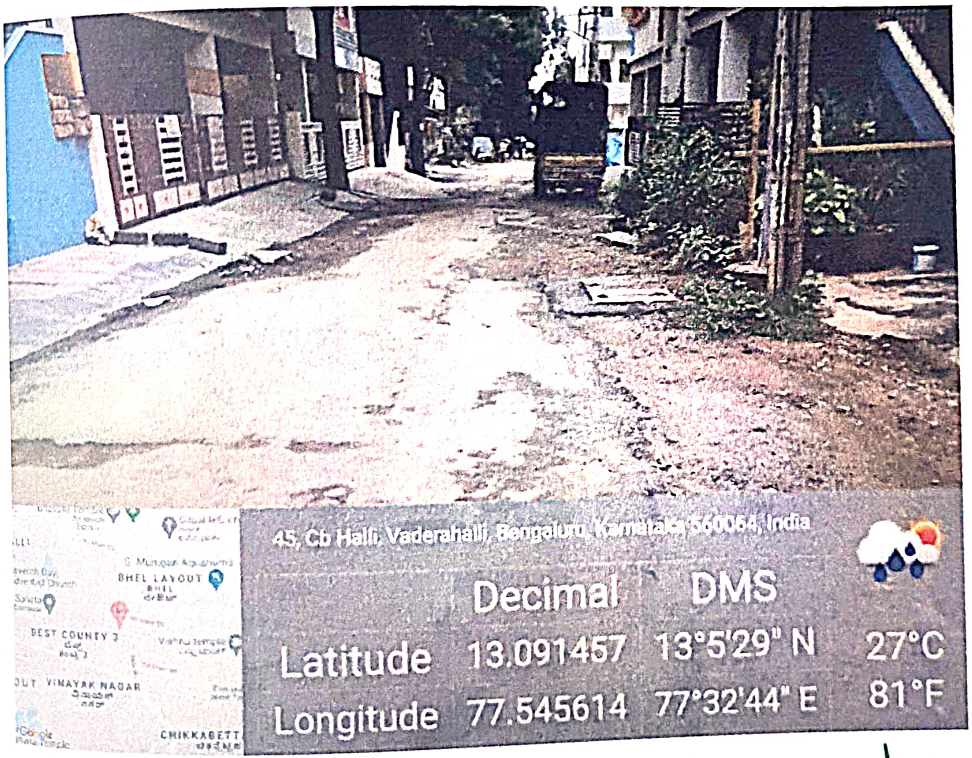

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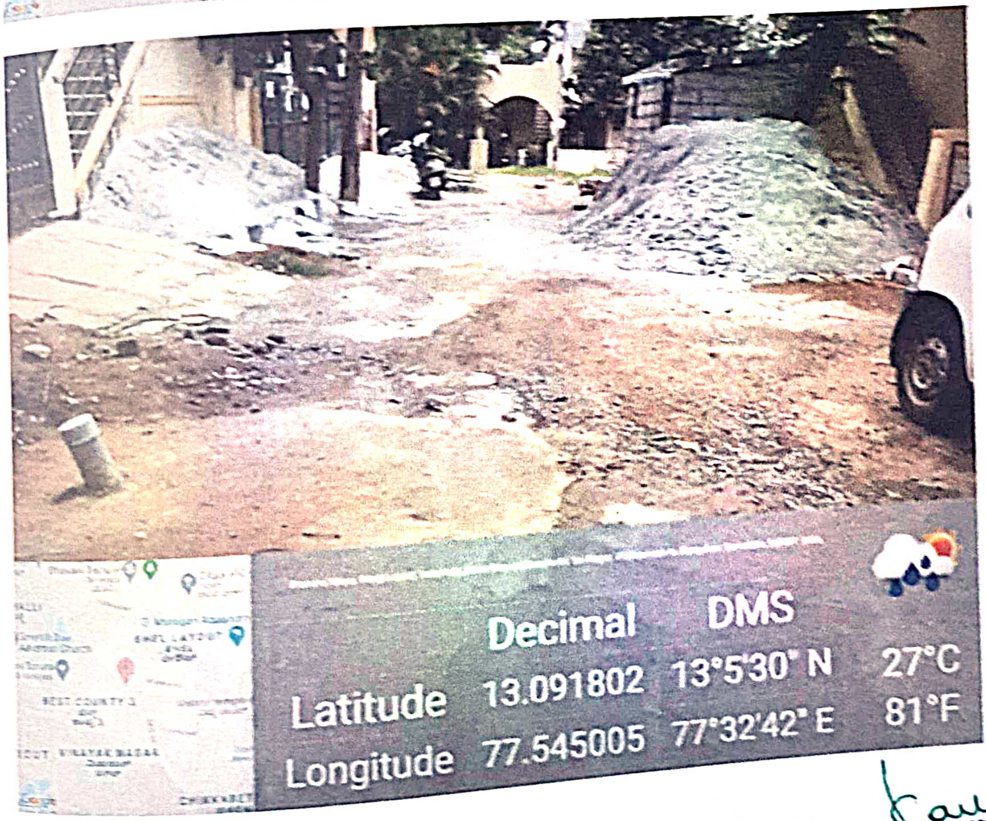

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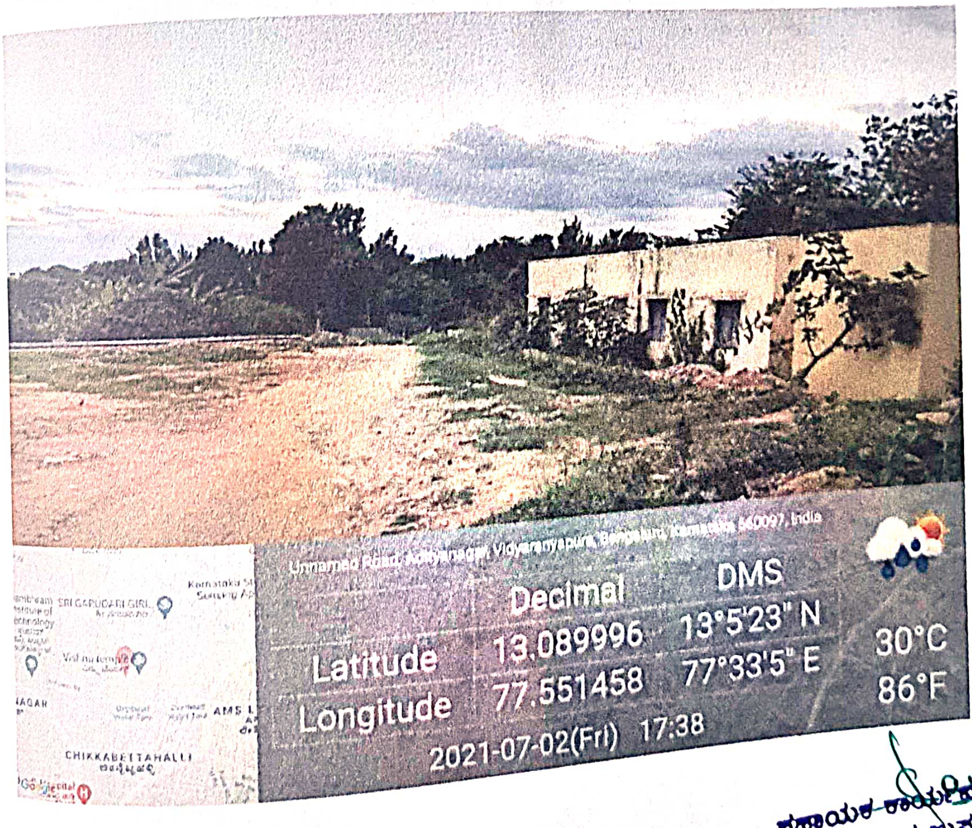

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ಬೃ.ಬೆಂ.ಮ.ಪಾ. ಬೆಂಗಳೂರು-106

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ಬೃ.ಬೆ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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ಬ.ಬ.ಎಂ.ಪ. ಬೆಂಗಳೂರು-106

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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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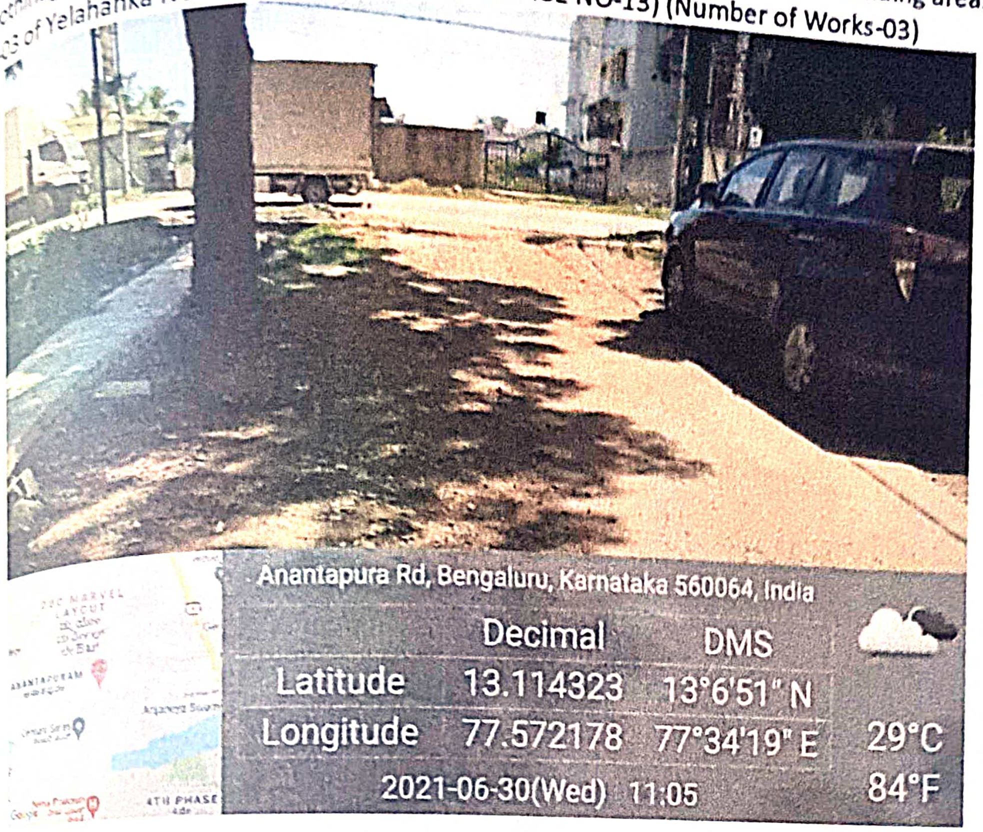

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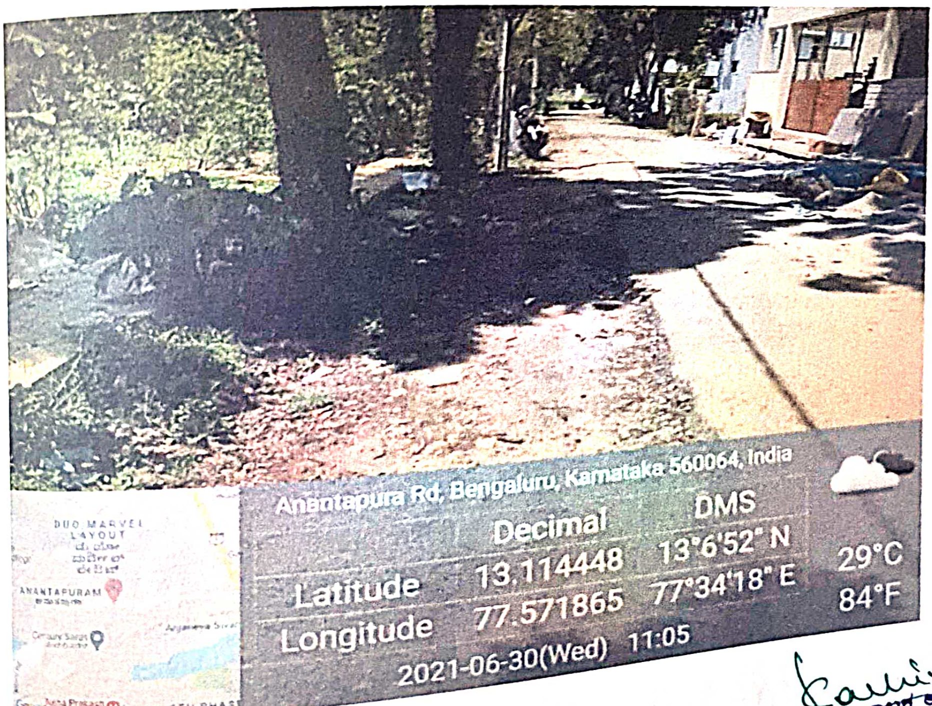

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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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ಯಲಹಂಕ ಉಪನಗರ ಉಪವಿಭಾಗ,
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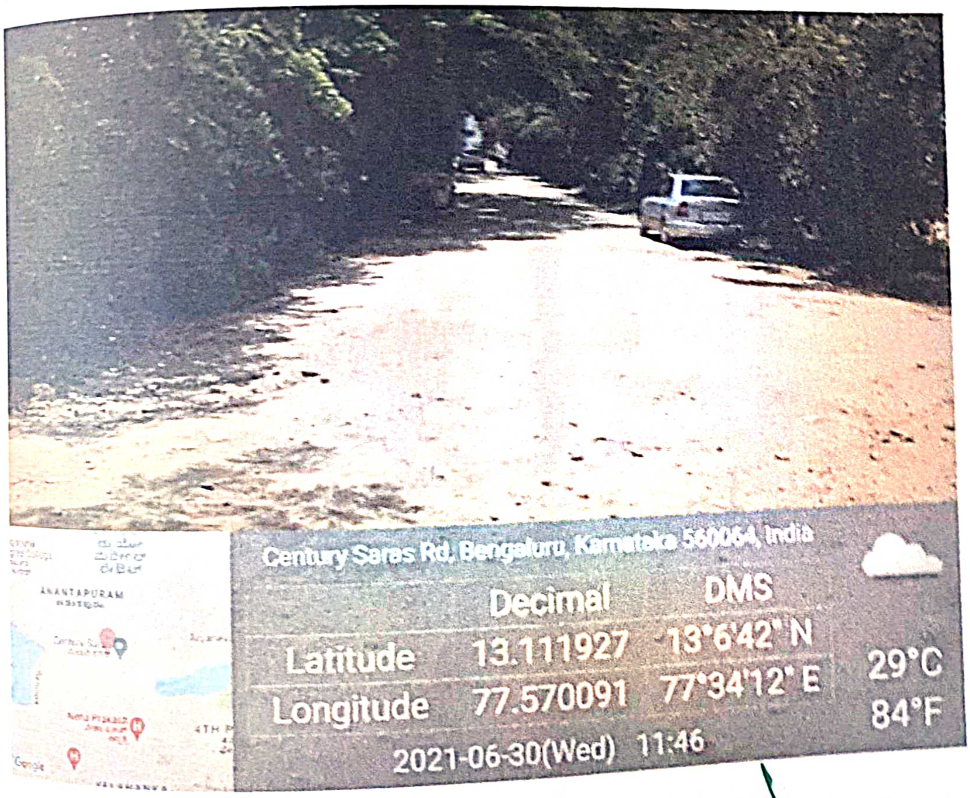

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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

...oration and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju ...out, Jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ...d no -03 of Yelahanka New town Sub division (PACKAGE NO-13) (Number of Works-03)

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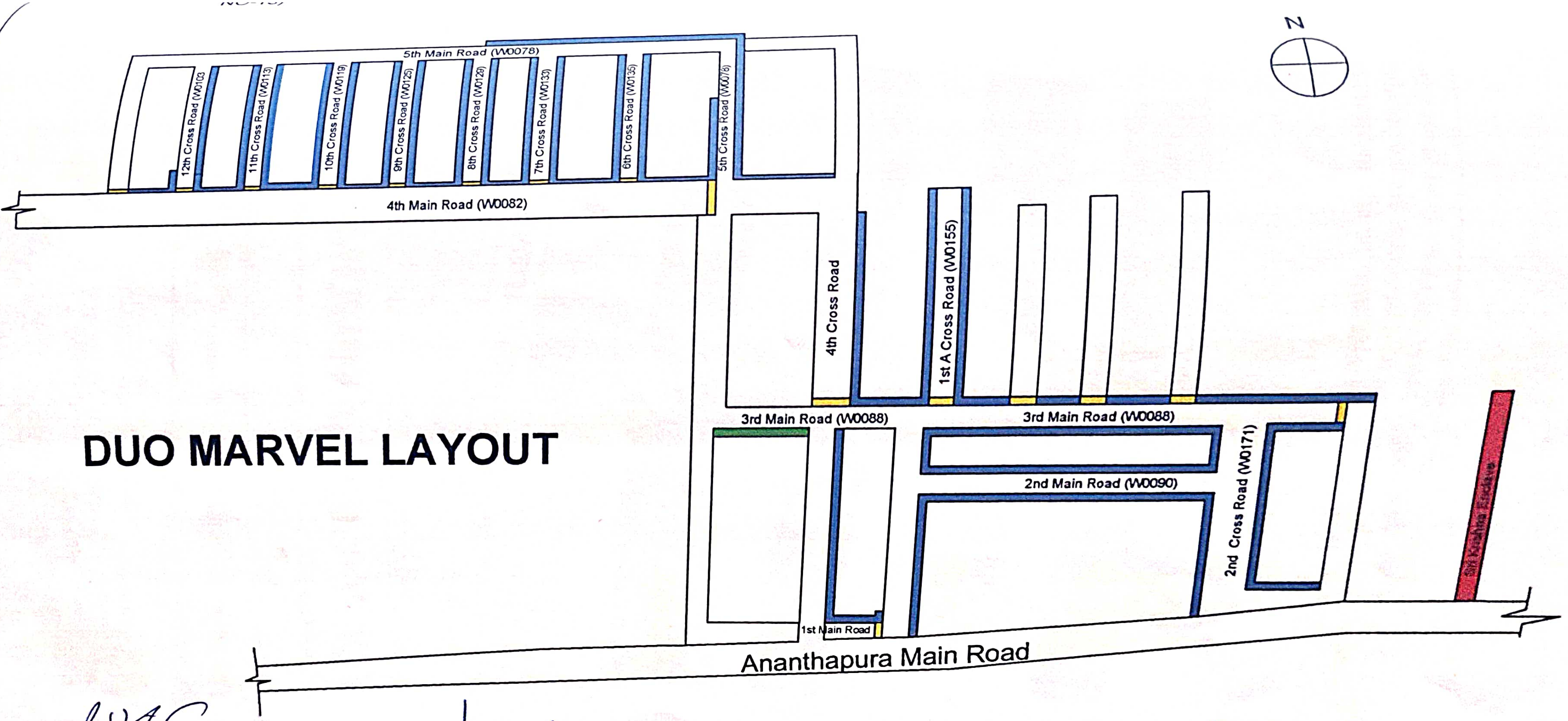
DUO MARVEL LAYOUT



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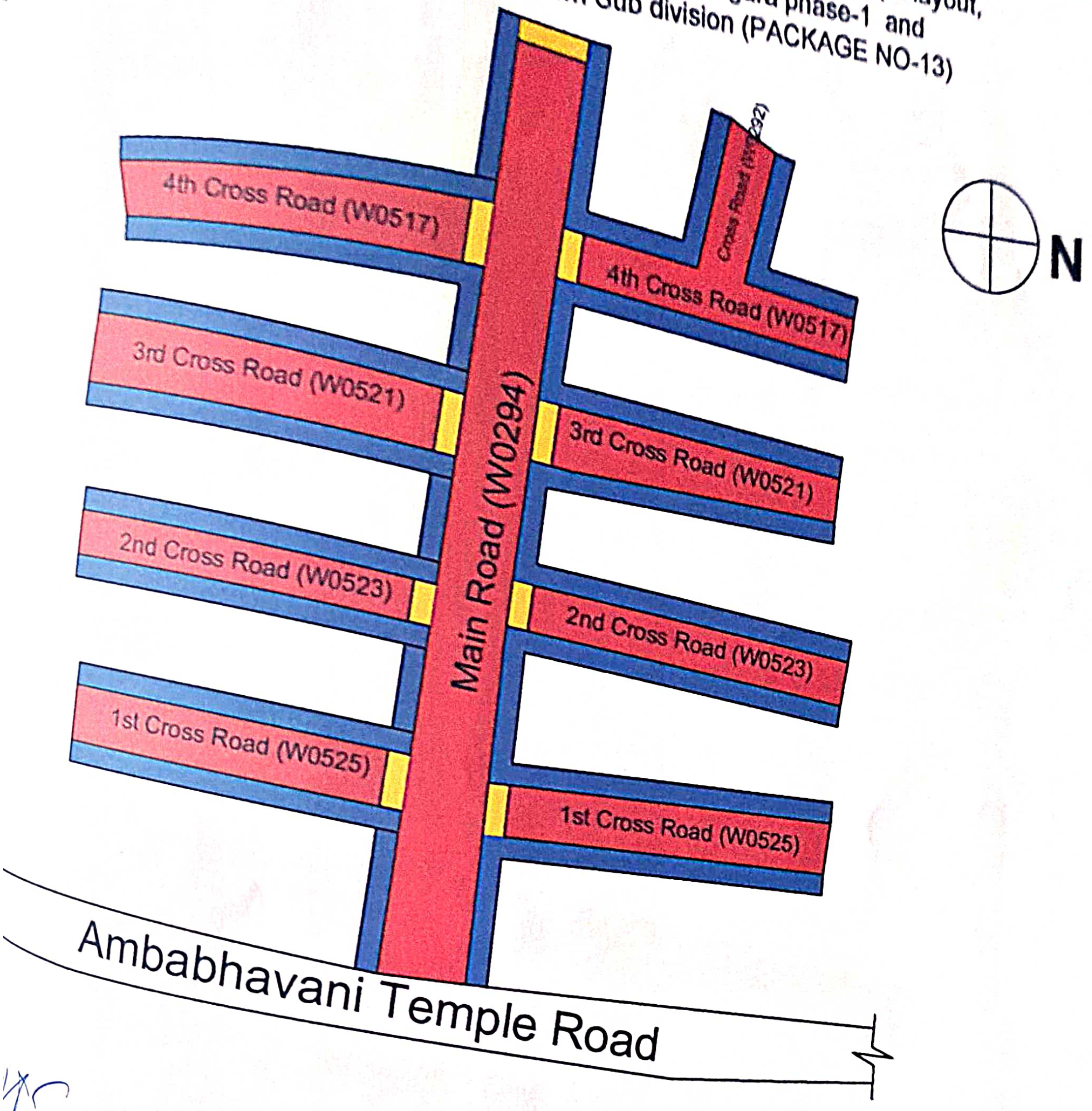
ಯಲಹಂಕ ಉಪನಗರ ಉಪವಿಭಾಗ
ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

INDEX

CC Drain with kerb | Culvert | CC drain | Asphalt Road

...ion and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout,
...layout, jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and
...ding areas in ward no -03 of Yelahanka New town Sub division (PACKAGE NO-13)



MUNIRAJU LAYOUT

INDEX		
Culvert	CC Drain with Kerb	Asphalt Road

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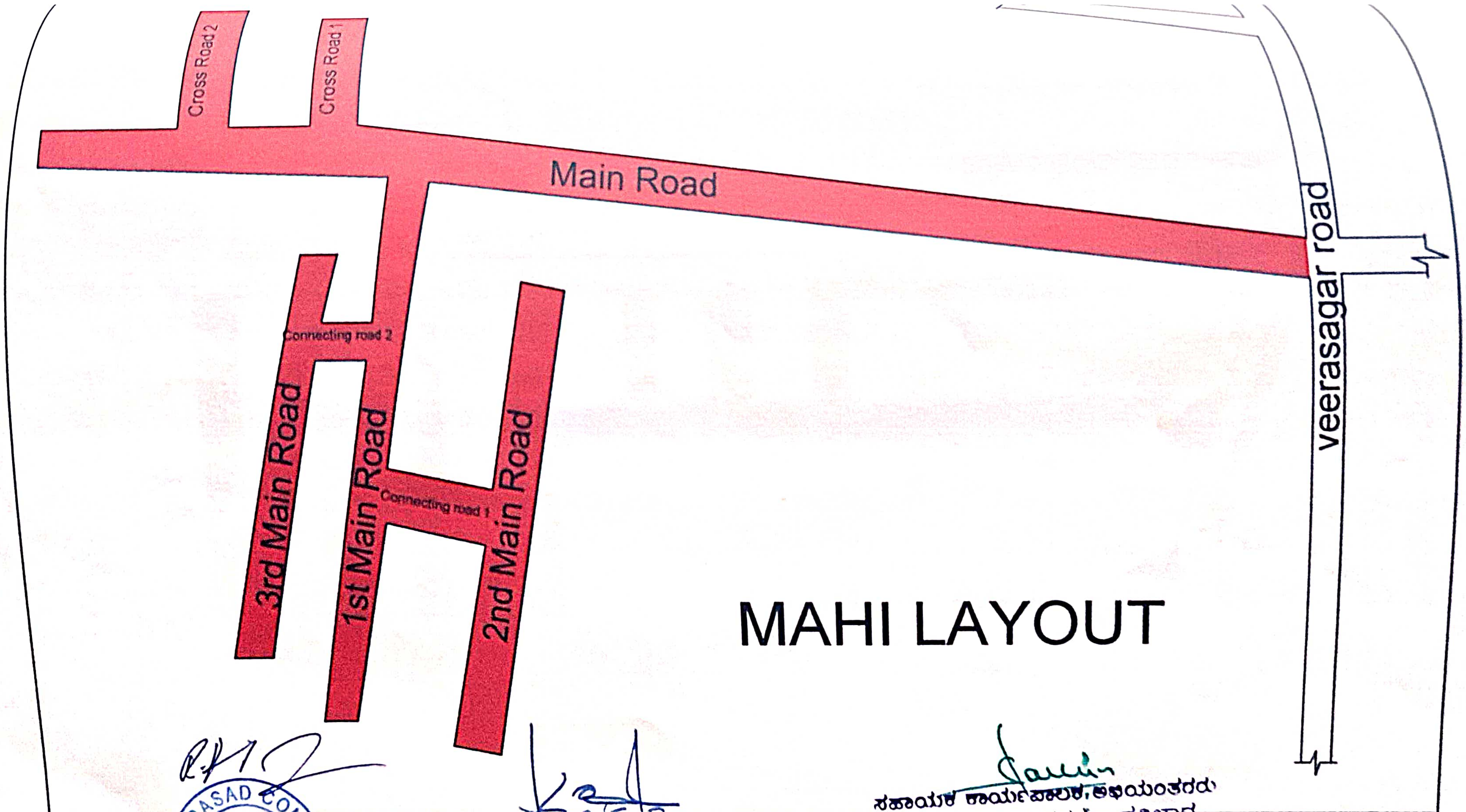
ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106



MAHI LAYOUT

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ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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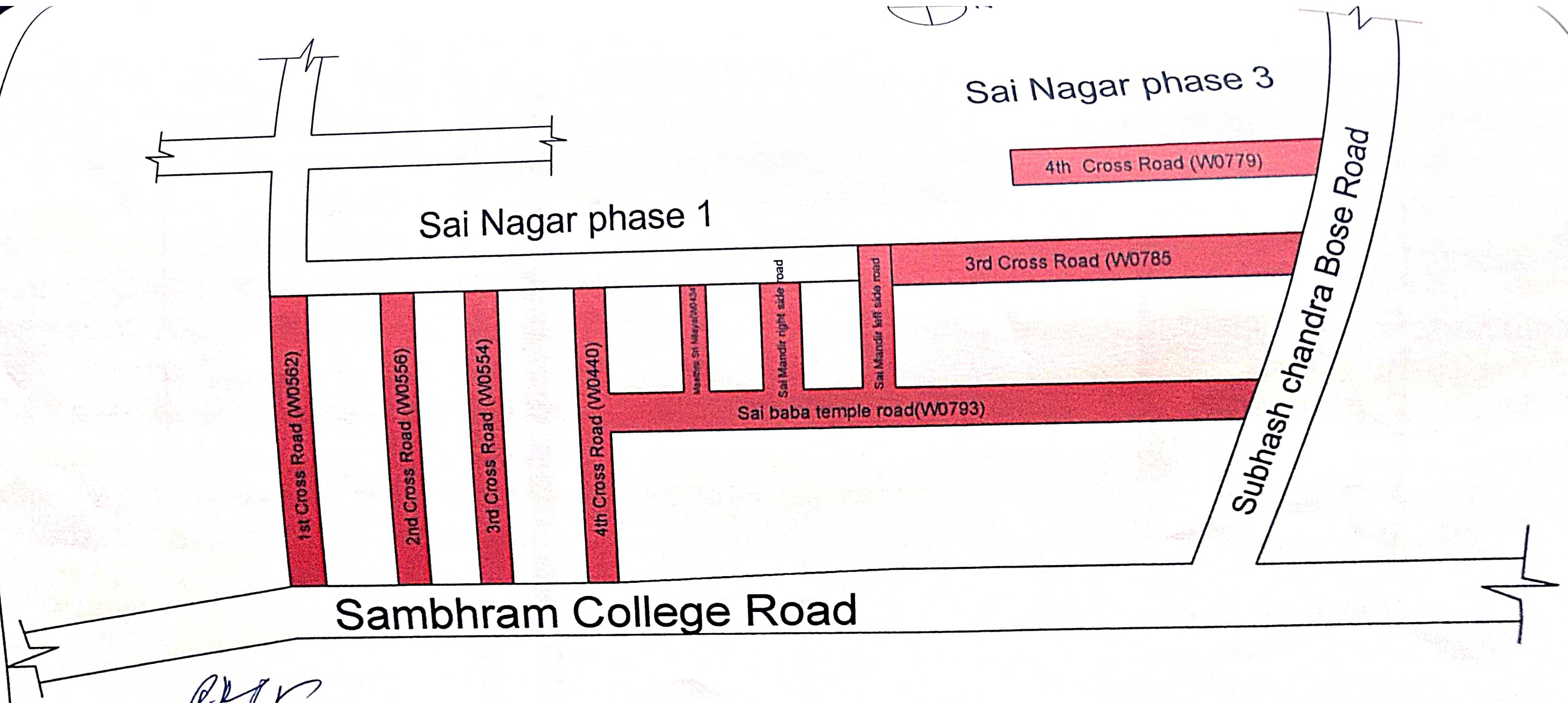
INDEX

Asphalt Road



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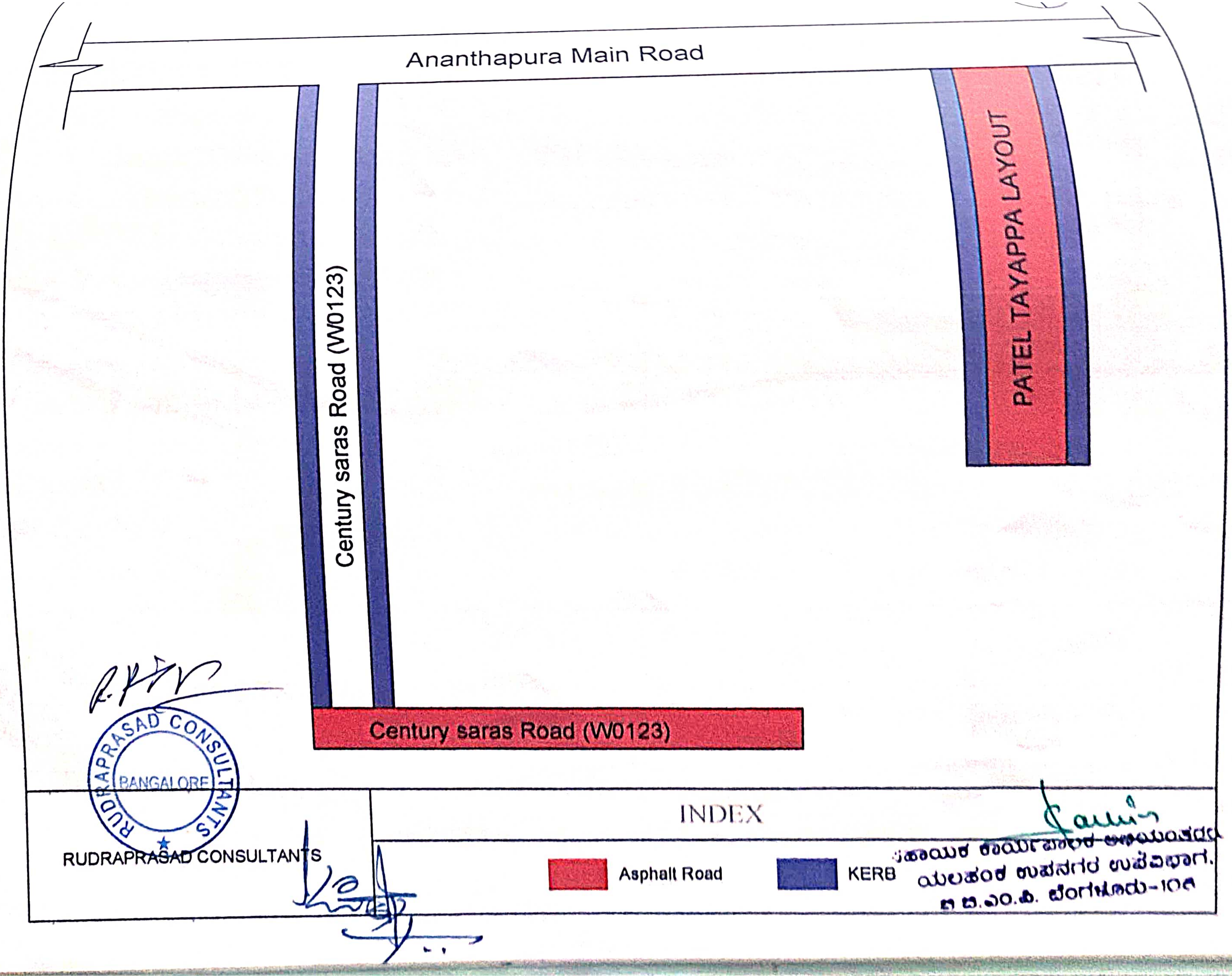
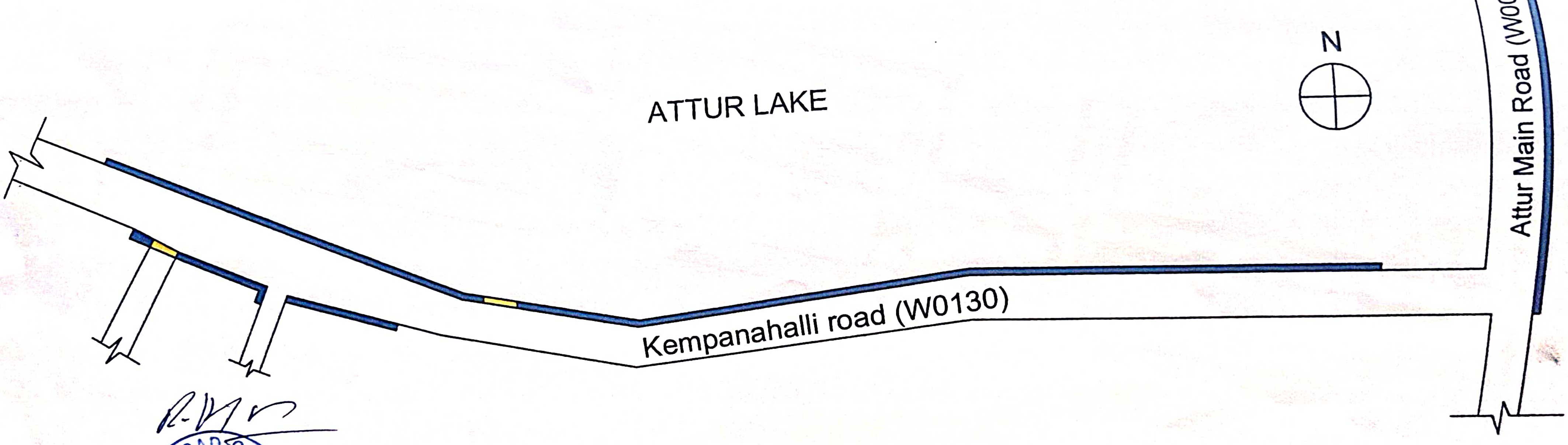
INDEX

Asphalt Road


Ananthapura Main Road
Century saras Road (W0123)
Century saras Road (W0123)
PATEL TAYAPPA LAYOUT
RUDRAPRASAD CONSULTANTS BANGALORE
RUDRAPRASAD CONSULTANTS
INDEX
Asphalt Road
KERB

Restoration and Improvements of Balance roads of Chowdeshwari layout, Mariyappa layout, Muniraju layout, jyothinagara 1st main road, Deo Marvel layout, Sainagara phase-1 and surrounding areas in ward no -03 of Yelahanka New town Sub division (PACKAGE NO-13)

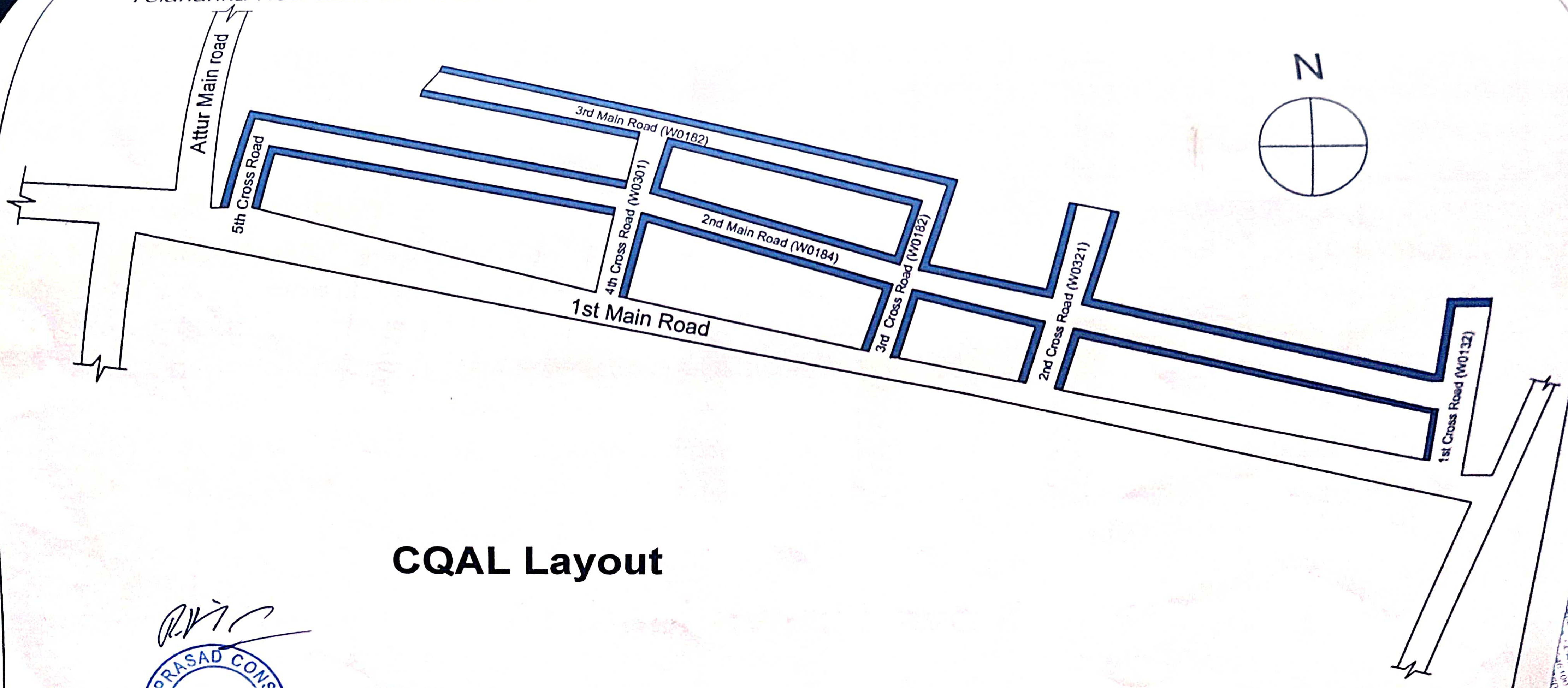


RUDRAPRASAD CONSULTANTS	INDEX	
	CC Drain with kerb	Culvert

RUDRAPRASAD CONSULTANTS BANGALORE

ಸಹಾಯಕ ಕಾರ್ಯಪಾಲಕ ಅಭಿಯಂತರರು
ಯಲಹಂಕ ಉಪನಗರ ಉಪವಿಭಾಗ.
ಬ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

Yelahanka New town Sub division (PACKAGE NO-13)



CQAL Layout

RUDRAPRASAD CONSULTANTS	INDEX
	CC Drain with Kerb

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ಯಲಹಂಕ ಉಪನಗರ ಉಪವಿಭಾಗ.
ಬಿ.ಬಿ.ಎಂ.ಪಿ. ಬೆಂಗಳೂರು-106

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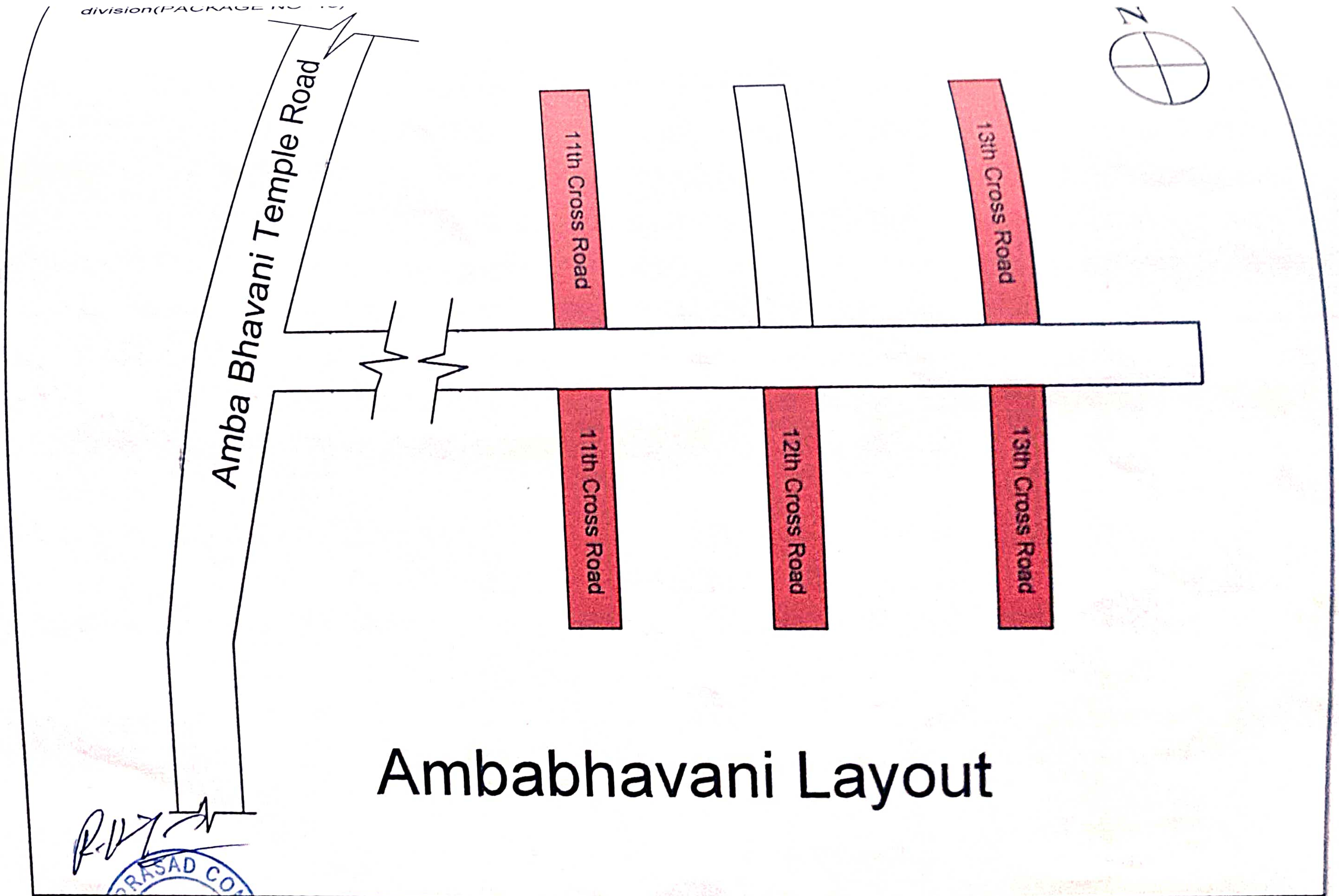

Ambabhavani Layout

RUDRAPRASAD CONSULTANTS	INDEX
	Asphalt Road